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ABSTRACT

This guide, intended to be used in teaching and learning, should enable students to master basic skills, acquire knowledge, and develop favorable attitudes in the areas emphasized. Contents of the guide are organized as follows: (1) Introductory section giving the course philosophy, general course objectives, instructional plan, and bibliography, (2) course outline (which includes the unit of fundamental AC and DC electronic theory; solid state and tube circuitry and theory; AM, FM, and audio systems analysis and troubleshooting; television and video system analysis and troubleshooting; systems maintenance, repair, and performance analysis; and customer relations and business management), and (3) written instructional aids consisting of job sheets, operation sheets, and sample information and assignment sheets. Over 70 suggested jobs are listed to provide experiences for the student in developing skill competencies. For each job, a corresponding job sheet tells the student what to do in performing the job. Information on the job sheet includes the material and equipment needed, safety precautions, specific procedures or steps, related teaching/learning activities, and methods of evaluation. Operation sheets supplement the job sheets and indicate how to perform the operations necessary to complete the assigned job. The supplementary information sheets and assignment sheets are to be prepared by the instructor following the samples provided. (Author/RG)

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TRADE AND INDUSTRIAL EDUCATION

COURSE OF STUDY

FOR

RADIO/TELEVISION REPAIR

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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PREFACE

In recent years, we have planned and constructed the finest of vocational education facilities and have placed fine equipment in these facilities. Equal attention must be directed to provide the teacher with the basic tools for instruction to assist in providing quality instruction.

This basic course of study is intended to be used as a teaching and learning guide. The information provides the basic skills of the occupation, so that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and advancement. The teacher who uses this course may find it necessary to modify and supplement the material to meet the needs of specific students and the local industrial community.

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1975

COURSE PHILOSOPHY

In keeping with the overall philosophy of vocational education, the Radio and Television Repair course will contribute to the development of individual students by providing them the opportunity to master basic skills, acquire knowledge, and develop favorable attitudes in the areas which the course emphasizes.

The relationship of mathematics, science and communications skills should be emphasized. Student awareness of responsibility to others must be emphasized. The student must be cognizant of changes within the industry and their effect on society and technology. The contribution of audio-visual media to society will be stressed.

A student should be aware of federal radio licensing regulations and encouraged to obtain appropriate licenses. All students should recognize their social responsibilities as they pertain to customer relations and business management.

GENERAL COURSE OBJECTIVES

Objectives	Activities to Achieve Objectives
1. To acquire the skill and knowledge necessary to use hand and power tools peculiar to the trade.	1. Use of instruction sheets. 2. Demonstrations. 3. Student use of tools and materials.
2. To develop the skill to use and acquire knowledge of instruments and test equipment used in the trade.	1. Use of instruction sheets 2. Demonstrations. 3. Job assignments for students.
3. To acquire knowledge of the principles and operation of radio, television, and other electronic equipment.	1. Use of instruction sheets. 2. Student job and written assignment. 3. Demonstrations and community resources.
4. To develop safe work habits and a desirable attitude toward safety.	1. Provide a clean, safe, well-lighted work environment. 2. Maintain a shop safety program with student personnel. 3. Use of posters and other audio-visual materials. 4. Provide appropriate incentive system for safe work habits.
5. To develop a sense of craftmanship, job responsibility, and communications skills.	1. Reading assignments. 2. Incentive system for evidence of quality work. 3. Student responsibility for completion of jobs. 4. Study ordering, requisition, and inventory procedures. 5. Allow students to assist each other.
6. To develop the ability to work well with others and with customers.	1. Plan class projects. 2. Provide for cooperative work arrangements. 3. Assist students in making personal adjustments to a work environment. 4. Provide role-playing situations for service and customer relations.
7. To develop an understanding of labor-management relations.	1. Employ community resources. 2. Conduct role-playing negotiation meetings.

PLAN OF INSTRUCTIONAL PRACTICES

Introduction

The effectiveness of instruction depends on the careful organization of the routine details concerning the pupil, equipment, teaching methods or physical details. The instructor must crystallize his thinking regarding the best teaching practices and must formulate a very definite statement of the basic standards to follow in teaching the course to bring about the attainment of the learning goals.

Teaching Methods

To achieve the desired results in this course, the following procedures should be applied:

1. Demonstrations--Operations and procedures will be portrayed, while the students observe. In the process of teaching, the purpose is to show how things are done safely and in the correct manner. Approximately 10 percent of the course time should be devoted to this activity as the need arises.

2. Class Discussion--A method of teaching in which students and the teacher take part, directed and controlled by the teacher to a predetermined objective. Technical and related information will be presented in this manner. Approximately five percent of the course time is suggested for class discussion.

3. Laboratory Talks--Short, informal talks by the instructor during laboratory activities, to convey information pertinent to the activity in session. This teacher activity is not a timed thing as it can apply at any time for periods of varying duration.

Vehicles of Instruction

The application phase of this course consists of work assignments kept as close to industrial conditions as a shop situation permits. Job, operation and information sheets will be provided, so that students of different levels of skill and ability can understand them. The students may progress as rapidly as possible, and achieve the standard set for the course. Special attention should be given to the unique student, offering special assistance at lower levels, and placing him in a position of leadership at the upper levels.

Live work--projects needed by the school, as well as by non-profit community organizations, may be utilized whenever available. Mockups and laboratory sets will be used to complete the laboratory experience defined in the course outline section.

Approximately 85 percent of the course time should be utilized for the application--student activity portion of this course.

Teaching Aids

Some of the teaching aids recommended for this course are films, film strips, overhead transparencies, chalkboard, tool display, industrial samples, brochures, speakers (professional/tradesmen), etc. A more complete list is given in the bibliography.

Items for Development by Local Teacher

The following items are peculiar to the local school situation and need to be developed by each local instructor.

- Standards of attainment required
- Pupil work evaluation
- Shop controls and regulations
- Pupil personnel organization
- Method of tool check
- Records and forms

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COURSE OUTLINE

Instructional Title: Radio and Television Repair Code: 17.1503

OCCUPATIONAL DESCRIPTION

Specialized theory and practice which is concerned with the installation, maintenance and repair of radio and television systems. Training also prepares students to diagnose troubles and make repairs on other electronic products such as high-fidelity sound equipment, phonographs, video and audio tape recorders, closed circuit television and community antenna television systems. The occupation is directly involved with consumer services in the repair of radio and television equipment. The work of the technician extends into commercial, industrial, civil and military communications, and the operation and repair of various electromechanical devices.

MAJOR DIVISIONS OF THE OCCUPATION

I. Fundamental AC and DC Electronic Theory

II. Solid State and Tube Circuitry and Theory

III. AM, FM and Audio Systems Analysis and Troubleshooting

IV. Television and Video Systems Analysis and Troubleshooting

V. Systems Maintenance, Repair and Performance Analysis

VI. Customer Relations and Business Management

Skill Competency Development Jobs

The following is a list of suggested jobs, assigned by the teacher, to provide experiences for the student to assist him in developing competencies of the Radio and Television Repair trade. These are Job Titles only. The numbers correspond with the identifying numbers on the Job Sheets that follow.

Unit I. Fundamental AC and DC Electronic Theory

J-1-1 Test for continuity

J-1-2 Test resistors

J-1-3 Analyze a series circuit

J-1-4 Analyze a parallel circuit

J-1-5 Test capacitors

J-1-6 Test inductors

J-1-7 Test transformers

J-1-8 Wire a stage

Unit II. Solid State and Tube Circuitry and Theory

J-2-1 Power Supply Testing (No B+)

J-2-2 AF Amplifier Testing (Dead Stage)

J-2-3 Detector and AVC Circuit Testing

J-2-4 IF Amplifier Stage Testing

J-2-5 Converter Stage Testing

J-2-6 Oscillator Testing

J-2-7 RF Amplifier Testing

J-2-8 Testing FM Detectors

J-2-9 Transducer Testing

Unit III. AM, FM and Audio Systems Analysis and Troubleshooting

J-3-1 Troubleshoot Stereo Amplifiers

J-3-2 Service Record Changers

J-3-3A	Repair audio tape equipment
J-3-3B	Repair audio tape drive
J-3-4	Troubleshoot public address systems
J-3-5	Troubleshoot FM stereo tuner
J-3-6	Align AM radios
J-3-7	Analyze a radio receiver using the radio analyst
J-3-8	Trace audio signals
J-3-9	Trace RF signals
J-3-10	Troubleshoot AM radios
J-3-11	Align FM receivers
J-3-12	Troubleshoot auto electronic sound equipment
J-3-13	Align FM stereo equipment

Unit IV. Television and Audio Systems Analysis and Troubleshooting

J-4-1	Set up and adjust black and white television receiver
J-4-2	Replace a black and white picture tube
J-4-3	Repair television low voltage power supplies
J-4-4A	Repair television high voltage power supplies
J-4-4B	Repair television high voltage power supplies--regulated system
J-4-5	Repair television tuners
J-4-6A	Repair video amplifiers (IF Stages)
J-4-6B	Repair video amplifiers (Output Stage)
J-4-7	Repair video detectors
J-4-8A	Repair AGC circuits
J-4-8B	Repair AGC circuits (Delay and RF)
J-4-9	Repair SYNC circuits
J-4-10A	Repair sweep circuits
J-4-10B	Repair sweep circuits oscillator and AFC stages

J-4-11 Operate TV analyst (RF output)

J-4-12 Perform a sweep alignment

J-4-13 Test for high voltage

J-4-14 Clean chassis and touch-up cabinet

J-4-15 Repair chroma circuits

J-4-16 Replace a color picture tube

J-4-17 Determine purity and tracking of a color picture tube

J-4-18 Perform convergence alignment

J-4-19 Align television sound circuits

J-4-20 Align chroma circuits

J-4-21 Perform a bench repair using a test CRT

Unit V. Systems Maintenance, Repair and Performance Analysis

J-5-1 Install and adjust a television receiver

J-5-2 Install a home FM and TV antenna

J-5-3 Install a MATV system

J-5-4 Install a closed circuit RF distribution system

J-5-5 Install a home music and intercom system

J-5-6 Service and repair a MATV system

J-5-7 Service and repair a video distribution system

J-5-8 Service and repair a home music and intercom system

J-5-9 Install a commercial sound system

J-5-10 Service a commercial sound system

Unit VI. Customer Relations and Business Management

J-6-1 Compose and use a repair order

J-6-2 Initiate stock and inventory control

J-6-3 Demonstrate correct telephone techniques

J-6-4 Prepare a plan of cost versus profit

J-6-5 Demonstrate proper handling of customer complaints

J-6-6 Demonstrate acceptable employer-employee communications

J-6-7 Compile a list of local safety requirements and regulations (N.E.C.)

Skill Competencies and Information Lessons

The left hand column lists the tasks of the occupation which form the skill competencies required of the student. These competencies should be demonstrated by the teacher and practiced by the student.

The information lessons outline the general technical information and knowledge needed to perform the skill competencies. These items represent a common information taught on a group instruction basis. Additional information will emerge to be taught on an individual student basis as pupils work on the skill competencies.

The numbers preceding each title correspond to the identifying numbers of the operation sheets and the information sheets. The information lessons relate to the particular major unit of instruction but do not necessarily relate to corresponding skill competency numbers.

Unit I. Fundamental AC and DC Electronic Theory

Skill Competencies/Operations		Information Lessons	
SC-1-1	Use of plier-type tools	IL-1-1	Safety lesson (Electrical)
SC-1-2	Use of driver-type tools	IL-1-2	Basic math for radio and TV servicing
SC-1-3	Use and care of soldering tools	IL-1-3	Powers of ten-conversion of units
SC-1-4	Apply wiring soldering techniques	IL-1-4	Equations for radio and TV
SC-1-5	Solder printed circuits	IL-1-5	Alternating current mathematics
SC-1-6	Measure resistance with a Volt-OHM-Milliameter	IL-1-6	Direct current electricity
SC-1-7	Measure voltage with a Volt-OHM-Milliameter	IL-1-7	Cells and batteries
SC-1-8	Measure current with a Volt-OHM-Milliameter	IL-1-8	Electrical circuits
SC-1-9	Test batteries	IL-1-9	E.I.A. Color codes
SC-1-10	Use of power drill	IL-1-10	Resistance and resistors
SC-1-11	Replace component	IL-1-11	OHM's Law
SC-1-12	Use a tube tester	IL-1-12	Electrical power

Skill Competencies/Operations		Information Lessons	
SC-1-13	Use a capacitor tester	IL-1-13	Schematic, block and pictorial diagrams
SC-1-14	Use a transistor tester	IL-1-14	Measuring devices--reading the complex scale instrument
		IL-1-15	Series circuits
		IL-1-16	Parallel circuits
		IL-1-17	Series--parallel circuits
		IL-1-18	Kirchoff's Laws
		IL-1-19	Magnetism and induced EMF
		IL-1-20	Alternating current electricity
		IL-1-21	Frequency and phase--peak and RMS values
		IL-1-22	Inductance and inductive reactance
		IL-1-23	Transformers
		IL-1-24	Capacitors and capacitive reactance
		IL-1-25	Filter circuits

II. Solid State and Tube Circuitry and Theory

Skill Competencies/Operations		Information Lessons	
SC-2-1	Measure tube voltages	IL-2-1	Electron tubes
SC-2-2	Measure tube resistances	IL-2-2	Rectifier circuitry
SC-2-3	Measure transistor voltages	IL-2-3	Filtering and voltage dividers
SC-2-4	Measure transistor resistances	IL-2-4	AC/DC power supplies
SC-2-5	Test a speaker	IL-2-5	Auto radio power supplies
SC-2-6	Check a microphone	IL-2-6	Tubes and biasing methods
SC-2-7	Test a phono pick-up	IL-2-7	Amplifiers(general)
SC-2-8	Check a tape head	IL-2-8	AF amplifiers
SC-2-9	Clean and demagnetize a tape head	IL-2-9	RF and IF amplifiers
SC-2-10	Replace a tape head	IL-2-10	Oscillators
SC-2-11	Test stereo headphones	IL-2-11	Demodulators
SC-2-12	Check crystal detectors	IL-2-12	Semiconductors and transistors
SC-2-13	Test a power diode	IL-2-13	Junction diodes--Power--Zener
SC-2-14	Replace a phono needle or cartridge	IL-2-14	PNP and NPN transistors
SC-2-15	Adjust automatic changer	IL-2-15	Transistor AF amplifiers
SC-2-16	Phase and connect speakers	IL-2-16	Transistor RF and IF amplifiers
SC-2-17	Clean controls, switches, contactors	IL-2-17	Transistor oscillators
SC-2-18	Use resistor and capacitor substitution boxes	IL-2-18	PC board servicing techniques
SC-2-19	Use Sam's service information	IL-2-19	Tube and transistor testing
SC-2-20	Read and draw schematic diagrams	IL-2-20	FET circuitry in radio
SC-2-21	Use Audio frequency generator	IL-2-21	IC use in radio receivers

Skill Competencies/Operations		Information Lessons
SC-2-22	Apply standard repair procedures	
SC-2-23	Calibrate a scope	
SC-2-24	Use scope probe	
SC-2-25	Use an oscilloscope	

III. AM, FM and Audio Systems Analysis and Troubleshooting

Skill Competencies/Operations		Information Lessons	
SC-3-1	Check a push pull amplifier	IL-3-1	Functions of a stereo audio amplifier
SC-3-2	Check for high fidelity audio distortion	IL-3-2	Audio distortion
SC-3-3	Match speaker impedance	IL-3-3	Impedance matching
SC-3-4	Troubleshoot with the radio analyst in the audio section	IL-3-4	Use and function of the radio analyst
SC-3-5	Troubleshoot with the radio analyst in the RF section	IL-3-5	Use and function of the radio analyst
SC-3-6	Align the RF and oscillator section of an AM SBC receiver	IL-3-6	AM radio alignment
SC-3-7	Align the IF section of an AM radio	IL-3-7	Use and functions of signal tracers
SC-3-8	Use schematic diagrams	IL-3-8	Modulation of a carrier
SC-3-9	Clean and lubricate record changer mechanisms	IL-3-9	Function of a record player
SC-3-10	Replace rubber drives on changer	IL-3-10	Reading mechanical prints
SC-3-11	Repair and lubricate tape mechanisms	IL-3-11	Use of electronic oils, solvents and chemicals
SC-3-12	Troubleshoot tape recorder bias and erase oscillators	IL-3-12	Functions of an audio tape recorder and player
SC-3-13	Place and balance public address speaker systems	IL-3-13	Use of public address systems
SC-3-14	Repair FM limiter and discriminator stages	IL-3-14	Use of microphones
SC-3-15	Align FM receivers	IL-3-15	Use of speakers
SC-3-16	Operate the FM stereo generator	IL-3-16	Frequency modulation
SC-3-17	Align the FM stereo decoder	IL-3-17	FM stereo and FM stereo alignment

Skill Competencies/Operations		Information Lessons	
SC-3-18	Operate a noise and distortion meter	IL-3-18	Antennas and their uses
SC-3-19	Remove and replace auto radio antennas	IL-3-19	Radio reception dealing with noise suppression
SC-3-20	Suppress noise in an auto radio		

IV. Television and Video Systems Analysis and Troubleshooting

Skill Competencies/Operations		Information Lessons	
SC-4-1	Remove and replace a television chassis	IL-4-1	Picture tube characteristics
SC-4-2	Remove and replace a black and white picture tube	IL-4-2	Electron beam scanning and deflection
SC-4-3	Adjust the yoke for level and center picture	IL-4-3	Use of fusing devices
SC-4-4	Replace fuse devices	IL-4-4	Circuit load conditions
SC-4-5	Replace low voltage rectifiers	IL-4-5	High voltage circuits
SC-4-6	Test for a short circuit	IL-4-6	Use of high voltage probes
SC-4-7	Use a high voltage probe	IL-4-7	Use and functions of TV tuners
SC-4-8	Replace high voltage rectifiers	IL-4-8	Dealing with high frequencies
SC-4-9	Replace high voltage rectifier filament circuits	IL-4-9	Functions of video amplifiers
SC-4-10	Replace high voltage transformers	IL-4-10	Functions of the video detector
SC-4-11	Solder in the high voltage circuit	IL-4-11	Stagger tuned IF circuits
SC-4-12	Check TV tuner construction	IL-4-12	Functions of the AGC circuits
SC-4-13	Adjust the oscillator section of a TV tuner	IL-4-13	Functions of SYNC and noise circuits
SC-4-14	Clean and lubricate TV tuners	IL-4-14	Functions of vertical sweep circuits
SC-4-15	Replace parts in a TV tuner	IL-4-15	Deflection yokes
SC-4-16	Check the video amplifier with an oscilloscope	IL-4-16	Functions of horizontal sweep circuits
SC-4-17	Adjust AGC and noise controls	IL-4-17	Use and function of the TV analyst
SC-4-18	Substitute external bias in the AGC circuit	IL-4-18	Use and function of the RF sweep generator

Skill Competencies/Operations		Information Lessons	
SC-4-19	Check SYNC with an oscilloscope	IL-4-19	Function of chroma circuits
SC-4-20	Substitute the SYNC signal with the TV analyst	IL-4-20	3.58 MC oscillators
SC-4-21	Adjust vertical sweep controls	IL-4-21	Color picture tube characteristics
SC-4-22	Check vertical sweep with the oscilloscope	IL-4-22	Parabolic waveforms
SC-4-23	Trigger vertical sweep from external source--vertical grid drive	IL-4-23	Convergence circuits
SC-4-24	Trigger vertical sweep from external source--vertical plate drive	IL-4-24	X-Ray radiation pertaining to color TV receivers
SC-4-25	Trigger vertical sweep from external source--solid state vertical stage)	IL-4-25	Colormetry
SC-4-26	Adjust horizontal sweep controls	IL-4-26	Intercarrier sound and TV sound circuits
SC-4-27	Repair the horizontal AFC circuit	IL-4-27	Automatic tuning circuits
SC-4-28	Repair horizontal oscillator circuits		
SC-4-29	Substitute horizontal sweep drive		
SC-4-30	Substitute horizontal sweep drive (plate)		
SC-4-31	Substitute tuner and video IF with the TV analyst		
SC-4-32	Substitute tuner and video IF with the TV analyst (IF Stages)		
SC-4-33	Substitute video signal with the TV analyst		

Skill Competencies/Operations		Information Lessons
SC-4-34	Substitute sound with the TV analyst (Audio stages)	
SC-4-35	Substitute sound with the TV analyst (IF stages)	
SC-4-36	Check the yoke and high voltage transformer with the TV analyst	
SC-4-37	Align trap circuits	
SC-4-38	Align the TV tuner with a sweep generator	
SC-4-39	Align the IF section with a sweep generator	
SC-4-40	Check the overall response curve	
SC-4-41	Adjust 3.58 MHz oscillator	
SC-4-42	Substitute color signal in the color circuits (chroma)	
SC-4-43	Align chroma bandpass	
SC-4-44	Align chroma SYNC circuits	
SC-4-45	Service ACC circuits	
SC-4-46	Remove and replace the color Kinescope (picture tube)	
SC-4-47	Adjust static and dynamic convergence	
SC-4-48	Adjust temperature of a color CRT	
SC-4-49	Adjust focus and high voltage in a color TV receiver	
SC-4-50	Repair and align automatic tuning circuits	
SC-4-51	Degauss a color CRT	
SC-4-52	Use the color bar generator	

V. Systems Maintenance, Repair and Performance Analysis

Skill Competencies/Operations		Information Lessons	
SC-5-1	Unpack television receiver	IL-5-1	Handle a television receiver
SC-5-2	Check for proper picture adjustments	IL-5-2	Adjust a television receiver in the home
SC-5-3	Check for proper color adjustments	IL-5-3	Give instruction on receiver operation
SC-5-4	Instruct customer on set operation	IL-5-4	Television signal propagation and behavior
SC-5-5	Survey for antenna installation site	IL-5-5	Types of television antennas
SC-5-6	Select the antenna	IL-5-6	Orientate an antenna
SC-5-7	Install and orient the antenna	IL-5-7	Types of antenna mounts
SC-5-8	Install an antenna rotor	IL-5-8	Use the field strength meter
SC-5-9	Install transmission wire	IL-5-9	Types of transmission cable
SC-5-10	Attach coaxial fittings	IL-5-10	Match impedances
SC-5-11	Calculate RF distribution losses	IL-5-11	Types of coaxial fittings
SC-5-12	Select a distribution amplifier	IL-5-12	Attach coaxial fittings
SC-5-13	Install a distribution amplifier	IL-5-13	RF distribution methods
SC-5-14	Install signal distribution boxes	IL-5-14	Calculate cable losses
SC-5-15	Install line tap-offs	IL-5-15	Types of distribution amplifiers
SC-5-16	Install signal splitters	IL-5-16	Mount distribution amplifiers, splitters, and tap-offs
SC-5-17	Measure signal levels and loss	IL-5-17	Signal splitters
SC-5-18	Analyze receiver malfunction	IL-5-18	Line tap-offs
SC-5-19	Determine receiver malfunction	IL-5-19	How to localize a receiver failure

Skill Competencies/Operations		Information Lessons	
SC-5-20	Analyze an intercom/music system failure	IL-5-20	Intercom connection methods
SC-5-21	Install audio wiring	IL-5-21	Audio distribution methods
SC-5-22	Install audio and television wiring	IL-5-22	Types of speaker enclosures
SC-5-23	Test an intercom/music system	IL-5-23	Speaker placement
SC-5-24	Install speakers and speaker enclosures	IL-5-24	Types of speakers
		IL-5-25	Types of intercom/music systems
		IL-5-26	P.A. systems
		IL-5-27	Distribute audio power
		IL-5-28	Types of microphones
		IL-5-29	Microphone replacement
		IL-5-30	Sound principles
		IL-5-31	Types of audio tape recorders
		IL-5-32	Magnetic recording principles
		IL-5-33	Safety in climbing
		IL-5-34	Care and storage of cathode ray tubes
		IL-5-35	Care and storage of magnetic tapes

VI. Customer Relations and Business Management

Skill Competencies/Operations		Information Lessons	
SC-6-1	Fill out a repair order	IL-6-1	Complete a repair order
SC-6-2	Route daily service calls	IL-6-2	Route service calls
SC-6-3	File completed repair orders	IL-6-3	File correspondence and records
SC-6-4	Complete a tube inventory	IL-6-4	Compile a parts inventory
SC-6-5	Complete a parts inventory	IL-6-5	Purchase efficiently
SC-6-6	Buy in discount quantities	IL-6-6	Telephone answering techniques
SC-6-7	Answer telephone	IL-6-7	Schedule service calls
SC-6-8	Schedule service calls	IL-6-8	Customer psychology
SC-6-9	Handle customer complaints	IL-6-9	Keep a business ledger
SC-6-10	Start a business ledger	IL-6-10	Proper record keeping
SC-6-11	Record debits, credits	IL-6-11	Employee-employer relations and responsibilities
SC-6-12	Determine proper dress for service calls	IL-6-12	Identify proper dress, grooming and behavior while on duty
SC-6-13	Practice employer loyalty	IL-6-13	Practicing employer loyalty
SC-6-14	Determine a fair wage for good workmanship		

WRITTEN INSTRUCTIONAL AIDS

Introduction

Instruction sheets are aids used in developing the most effective and efficient teaching-learning situation that is possible. Four types of sheets are generally used including job sheets, operation sheets, information sheets and assignment sheets.

The JOB involves a sequential performance of operations by the learner to "tryout" and develop the skill competencies (operations) of the occupation resulting in a product or service. It is the vehicle of instruction or the media by which the student practices and develops a series of skill competencies (operations). JOB SHEETS indicate to the student what to do in performing the various jobs assigned by the instructor. The jobs that will be used as vehicles of the instruction in the course are listed in the COURSE OUTLINE section.

OPERATIONS are the subdivisions in the breakdown of a job. Each operation represents a process, way of doing or how to perform the particular skill competency or operation.

OPERATION SHEETS supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. The operations that will be taught in the course are listed in the COURSE OUTLINE section under skill competencies/operations. The operation sheets should be numbered to correspond with the Skill Competencies listed in the course outline.

INFORMATION SHEETS supplement the job sheets and provide the student with information necessary for completing the assigned jobs with highest possible degree of understanding. The information units that will be stressed in the course are listed in the course outline under information lessons. The information sheets included in this section should be numbered to correspond with the Information Lessons listed in the course outline.

ASSIGNMENT SHEETS supplement the job sheets and provide the student with mental activities necessary to learn the "knowing" that accompanies the "doing" of a trade. The student is assigned related studies or technical information to be "sought out" by the student on an individual basis through the use of problems or "exercises."

JOB: Test for Continuity

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-1

MATERIAL: Wire
Vacuum tube (any type)

EQUIPMENT: VOM
VTVM

SAFETY PRECAUTIONS:

VTVM must be plugged into A.C.isolated power.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain piece of wire.	. SC-1-6
2. Check wire for continuity with VOM.	. SC-2-2
3. Repeat continuity with VTVM.	
4. Secure vacuum tube from stock and test filament for continuity.	

METHOD OF EVALUATION:

1. Meter alignment
2. Correct meter function
3. Accuracy of measurement

JOB: Test Resistors

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-2

MATERIAL:
1 Resistor
1 Meg Resistor
10 Ohms Resistor
10K Resistor
100 K Resistor

EQUIPMENT: VTVM

SAFETY PRECAUTIONS:

Plug VTVM into isolated A.C. power supply.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure assigned resistors with VTVM. 2. Compare measured resistance with color band value. 3. Record and compare the difference, if any, and turn in to instructor.	. SC-1-6

METHOD OF EVALUATION:

1. Meter alignment
2. Correct meter function
3. Accuracy of measurement

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1-3

JOB: Analyze a Series Circuit

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

MATERIAL:
- 1K Resistor
- 100 K Resistor
- 10 K Resistor
- Bread board
- Hook-up wire
- Schematic

EQUIPMENT:
- 0-30 Volt DC power supply
- VOM

TOOLS: Long nose pliers

SAFETY PRECAUTIONS:

Hook-up all tests and procedures with power off.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain schematic drawing from instructor.	
2. Obtain all parts and material from stockroom.	
3. Wire circuit according to schematic diagram.	. SC-1-1
4. Insert VOM for current reading at point indicated.	
5. Turn power on and measure and record current readings at points indicated, with 10 volt DC input.	. SC-1-8
6. Repeat Step 5 with 20 volt DC input.	

METHOD OF EVALUATION:

1. Correct circuit assembly
2. Correct meter function
3. Correct selection of measurement points
4. Accuracy of measurement

JOB: Analyze a Parallel Circuit

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-4

MATERIAL: Variable power supply
Bread board
1 Meg - 1 watt resistor
56 K - 1 watt resistor

EQUIPMENT: VOM
VTVM

SAFETY PRECAUTIONS:

Make all connections to circuit with power off.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING LEARNING ACTIVITIES
1. Obtain schematic drawing from instructor.	
2. Obtain parts and equipment from stockroom.	
3. Wire circuit from diagram.	. SC-1-1
4. Insert VOM at points indicated in diagram.	
5. Turn power on, measure and record current with 10 volt DC input.	. SC-1-8
6. Measure and record voltage across parallel branches where indicated on diagram with VTVM.	. SC-1-7
7. Repeat Step 5 with 30 volt DC input.	. SC-1-8
8. Repeat Step 6 with 30 volt DC input.	. SC-1-7

METHOD OF EVALUATION:

1. Correct circuit assembly
2. Correct meter function
3. Correct selection of measurement points
4. Accuracy of measurement

JOB: Test Capacitors

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-5

MATERIAL: .05 MFP Capacitor
40 MFD C 450 Volt Capacitor
20 MFD C 150 Volt Capacitor Shorted Capacitor

EQUIPMENT: VOM or VTVM
Capacitor tester

SAFETY PRECAUTIONS:

Plug all A.C. line operated test equipment into isolated power source.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain all parts and equipment from stockroom.	
2. Check all capacitors for open or short with VOM and VTVM.	. SC-1-6
3. Check all capacitors for rated value with capacitor testors. Record the differences, if any.	. SC-1-13
4. Measure and record power factor of all electrolytic capacitors.	

METHOD OF EVALUATION:

1. Meter alignment
2. Correct meter function
3. Accuracy of measurement

JOB: Test Inductors

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-6

MATERIAL: Three assorted inductors

EQUIPMENT: VOM
VTVM

SAFETY PRECAUTIONS:

Plug all A.C.line operated equipment into isolated power source.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain three assorted inductors from stock.	
2. Identify inductor from information supplied with inductor.	
3. Check inductors for continuity.	. SC-1-6
4. Record the resistance measured of the three inductors.	

METHOD OF EVALUATION:

1. Meter alignment
2. Correct meter function
3. Accuracy of measurement

JOB: Test Transformers

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-7

MATERIAL: 117 volt A.C.Primary
6.3 volt A.C.Secondary Transformer
A.C.power cord

EQUIPMENT: VOM
VTVM

SAFETY PRECAUTIONS:

Transformer and A.C.line operated equipment must be plugged into isolated power source.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain parts and equipment from stockroom.	
2. With power off, check transformer primary and secondary for continuity. Measure and record resistance value of transformer primary and secondary.	. SC-1-6
3. Clip A.C.power cord to transformer primary winding. Plug transformer into isolated 117 volt A.C.power. Measure and record transformer secondary volt A.C.	. SC-1-7

METHOD OF EVALUATION:

1. Meter alignment
2. Correct meter function
3. Accuracy of measurement

JOB: Wire a Stage

UNIT I: Fundamental AC and DC Electronic Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-1-8

MATERIAL:
- Resistors
- Capacitors
- Chassis
- Solder
- Hook-up wire
- Tube socket
- 6 AV6 tube
- Hardware

EQUIPMENT: D.C.power supply

TOOLS:
- Diagonal cutters
- Soldering gun
- Long nose pliers
- Hand power drill
- Chassis punch

SAFETY PRECAUTIONS:

Plug all A.C.line operated equipment into isolated power source.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Secure schematic diagram from instructor.	. SC-1-1
2. Secure necessary parts and tools from stockroom.	. SC-1-2
3. Make hole in chassis with drill and chassis punch.	. SC-1-3
4. Mount tube socket with associated hardware.	. SC-1-4
5. Wire stage from schematic diagram.	. SC-1-10
6. Solder all connections.	. SC-1-11
7. Have instructor check the finished product.	
8. Connect D.C.power, 6 volt, to filament connection indicated on diagram.	
9. Turn power on, observe if tube filament glows.	

METHOD OF EVALUATION:

1. Layout
2. Accuracy of measurements
3. Circuit assembly
4. Solder techniques

JOB: Power Supply Testing (No B+)

UNIT II: Solid State and Tube Circuitry and Theory

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-1

COURSE: Radio and Television Repair

EQUIPMENT: Radio Chassis (bugged) VOM
Transistor analyst Schematic Diagram

SAFETY PRECAUTIONS:

Use isolation transformer. Start meter readings on high range.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check power supply connections.	. SC-1-1
2. Check ON-OFF switch.	. SC-1-2
3. Check fuse or circuit breaker.	. SC-1-3
4. Measure transformer voltages and test, if necessary.	. SC-1-4
5. Check rectifier diode(s).	. SC-1-6
6. Check filter capacitors.	. SC-1-7
7. Check power supply choke.	. SC-1-13
8. Check voltage divider.	. SC-2-1
9. Replace defective component.	. SC-2-2
10. Standard repair procedures.	. SC-2-20
11. Check for normal operation.	. SC-2-22
12. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: AF Amplifier Testing (Dead stage)

UNIT II: Solid State and Tube Circuitry and Theory

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-2

COURSE: Radio and Television Repair

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- AF Generator
- VOM
- Isolation Transformer
- Signal Tracer
- Tube Tester
- Radio Chassis (bugged)
- Transistor Tester

TOOLS:
- Soldering pencil
- Diagonal cutters
- Long nose pliers
- Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Signal-inject AF stages.	. SC-1-1 through SC-1-16
2. Signal-trace AF stages.	
3. Check transistors or tubes.	
4. Check speaker.	
5. Check transistor or tube stage voltages.	
6. Check transistor or tube stage resistances.	
7. Check stage components.	
8. Check controls and switches.	
9. Repair/replace defective component.	
10. Standard repair procedures.	
11. Check for normal operation.	
12. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Detector and AVC Circuit Testing

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-3

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- AF-RF Generator
- Signal Tracer
- VOM
- Schematic Diagram
- Transistor or Tube Tester

TOOLS:
- Soldering pencil
- Long nose pliers
- Diagonal cutters
- Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Signal-inject detector stage.	. SC-1-1 through SC-1-16
2. Signal-trace detector stage.	. SC-2-1
3. Check crystal or tube diodes.	. SC-2-2
4. Measure diode/tube voltages.	. SC-2-3
5. Measure diode/tube stage resistances.	. SC-2-4
6. Standard repair procedures.	. SC-2-13
7. Check for normal operation.	. SC-2-20
8. Make up repair bill.	. SC-2-22
	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: IF Amplifier Stage Testing

UNIT II: Solid State and Tube Circuitry and Theory

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-4

MATERIAL: Wire
Solder
Spaghetti

EQUIPMENT: AF-RF Generator
Signal Tracer
VOM
Transistor or Tube Tester
Schematic Diagram

TOOLS: Soldering pencil
Long nose pliers
Diagonal cutters
Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Signal-inject IF stage(s).	. SC-1-1 through SC-1-16
2. Signal-trace IF stage(s).	
3. Check transistors or tubes.	
4. Measure stage voltages.	
5. Measure stage resistances.	
6. Check stage components.	
7. Standard repair procedures.	. SC-2-22
8. Check for normal operation.	
9. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Converter Stage Testing

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-5

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- AF-RF Generator
- Signal Tracer
- VOM
- Schematic Diagram
- Isolation Transformer
- Transistor or Tube Tester

TOOLS:
- Soldering pencil
- Long nose pliers
- Diagonal cutters
- Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Signal-inject converter.	. SC-1-1 through SC-1-16
2. Signal-trace converter.	. SC-2-1 through SC-2-4
3. Check oscillator portion.	
4. Check transistor or tube.	
5. Measure stage voltages.	
6. Measure stage resistances.	
7. Check stage components.	
8. Standard repair procedures.	. SC-2-22
9. Check for normal operation.	
10. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Oscillator Testing

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-6

MATERIAL: Wire, Solder, Spaghetti

EQUIPMENT: Oscilloscope, VOM, RF Generator, Schematic Diagram

TOOLS: Pencil iron, Long nose pliers, Diagonal cutters, Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformers.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check transistor or tube.	. SC-1-1 through SC-1-16
2. Check oscillator bias.	
3. Check stage components.	
4. Measure stage voltages.	. SC-2-1 through SC-2-4
5. Measure stage resistances.	
6. Standard repair procedures.	
7. Replace defective component.	
8. Check for normal operation.	. SC-2-22
9. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: RF Amplifier Testing

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-7

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- AF-RF Generator
- VOM
- Isolation Transformer
- Signal Tracer
- Schematic Diagram
- Transistor or Tube Tester

TOOLS:
- Soldering pencil
- Long nose pliers
- Diagonal cutters
- Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Signal-inject RF stage(s).	. SC-1-1 through SC-1-16
2. Signal-trace RF stage(s).	. SC-2-1 through SC-2-4
3. Check transistors or tubes.	. SC-2-13
4. Measure stage voltages.	
5. Measure stage resistances.	
6. Check stage components.	
7. Standard repair procedures.	. SC-2-20
8. Check for normal operation.	. SC-2-22
9. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Testing FM Detectors

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-8

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- AF-RF Generator
- VOM
- FM Sweep Generator
- Schematic diagram

TOOLS:
- Pencil iron
- Long nose pliers
- Nutdrivers
- Diagonal cutters
- Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sweep the stage and monitor output.	. SC-1-1 through SC-1-16
2. Check transistors, diodes, tubes.	
3. Measure stage voltages.	
4. Measure stage resistances.	
5. Check stage components.	
6. Replace defective component.	
7. Standard repair procedures.	. SC-2-20
8. Check for normal operation.	. SC-2-22
9. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Transducer Testing

UNIT II: Solid State and Tube Circuitry and Theory

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-9

MATERIAL:
- Wire
- Solder
- Spaghetti

EQUIPMENT:
- Signal tracer
- Test tape
- Test record
- AF Generator
- VOM
- Isolation transformer

TOOLS:
- Nutdrivers
- Screwdrivers
- Soldering pencil
- Long nose pliers
- Diagonal cutters

SAFETY PRECAUTIONS:

Use isolation transformer.
Do not apply ohmmeter to crystalline transducers.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check for normal output from transducer.	
2. Measure continuity of non-crystalline transducers.	
3. Check mechanical mounting and adjustments.	
4. Repair or replace transducer.	. SC-2-22
5. Make up repair bill.	. SC-6-1

METHOD OF EVALUATION:

1. Trouble shooting procedure
2. Component removal and replacing technique
3. Testing procedure
4. Correct billing

JOB: Troubleshoot Stereo Amplifiers

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Tubes
Transistors
Capacitors

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-1

DRAWING NUMBER: Sams Photofacts

EQUIPMENT: Audio signal generator
Volt Meter
Oscilloscope
Signal tracer
Ohm meter

TOOLS: Nut driver kit
Solder gun
Solder aid
Hand tools
Diagonal cutters
Long nose pliers

SAFETY PRECAUTIONS:

1. Use isolation transformer on all A.C. liner operated equipment.
2. Set meters on highest range to start testing.
3. Disconnect A.C. power before using Ohm meter.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test tubes or transistors.	. SC-3-1
2. Signal-inject audio preamp stage.	. SC-3-2
3. Signal-inject audio driver stage.	. SC-3-4
4. Signal-inject audio output stage.	. SC-3-8
5. Locate defective stage.	
6. Check for voltages.	
7. Check for defective connections.	
8. Check for defective component.	
9. Make necessary repairs as a result of the checking operations performed.	NOTE: Give unit under repair heat-up time after repairing the defective circuits.

METHOD OF EVALUATION:

1. Instructor will inject a square valve to evaluate the display on the oscilloscope.
2. Evaluate procedure and time required to complete repairs.

JOB: Service Record Changers

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-2

DRAWING NUMBER: Sams Photofacts

MATERIAL:
- Idler Wheel
- Drive wheels
- Motors
- Oil
- Belts

EQUIPMENT:
- Strobe disc
- Vita drive

TOOLS:
- Nut driver kit
- Diagonal cutters
- Solder guns
- Hand tools
- Long nose pliers
- Solder aids

SAFETY PRECAUTIONS:

Disconnect A.C. power from unit when removing changer from case.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check turn table speed.	. SC-3-9
2. Check drive wheels for wear.	. SC-3-11
3. Check idle wheel for wear.	
4. Clean wheels for tractions with vita drive.	
5. Oil bearings.	CAUTION: Do not over oil.
6. Replace worn wheels and belts.	NOTE: Make sure the record drops correctly and does not slow the turn table.
7. Replace in cabinet.	
8. Check speed with strobe disc and test record.	Check stylus pressure and the surface pressure of arm.

METHOD OF EVALUATION:

1. Instructor will check turn table speed with a strobe disc and test record.
2. Repair procedures.
3. Determine time needed to complete repairs.

JOB: Repair Audio Tape Equipment

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-3A

DRAWING NUMBER: Sams Photofacts

MATERIAL:
- Tubes
- Capacitors
- Transistors
- Resistors

EQUIPMENT:
- Audio signal generator
- Volt meter
- Ohm meter
- Signal tracer
- Oscilloscope

TOOLS:
- Long nose pliers
- Solder gun
- Hand tools
- Diagonal cutters
- Assorted nut drivers

SAFETY PRECAUTIONS:

1. Use isolation transformer on all A.C. line operated equipment.
2. Set meters on highest range to start. Discharge all large capacitors before testing with the Ohm meter.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test transistors with tester.	. SC-3-1
2. Signal-inject preamp stage.	. SC-3-2
3. Signal-inject driver stage.	. SC-3-4
4. Signal-inject output stage.	. SC-3-8
5. Check speaker.	. SC-3-14
6. Check erase oscillator.	
7. Check B plus voltage.	
8. Check for defective component.	
9. Check for defective connections.	
10. Make necessary repairs as a result of the checking operations performed.	

METHOD OF EVALUATION:

1. Instructor will record and play back a tape on repaired unit.
2. Instructor will evaluate time and procedure required to complete repairs.

JOB: Repair Audio Tapes Drives

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-3B

DRAWING NUMBER: Sams Photofacts

MATERIAL:

Drive belts	Idler sheels
Vita drive	Resin
Solder	Oil

EQUIPMENT: Speed strobe disc

TOOLS:

Hand tools	Solder gun
Nut drivers	Flashlight
Solder aid	

SAFETY PRECAUTIONS:

1. Use isolation transformer on all A.C. line operated equipment.
2. Disconnect power before removing unit from case.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check tape speed.	. SC-3-8
2. Check drive wheels.	. SC-3-10
3. Check drive belts.	. SC-3-12
4. Clean all drive areas.	. SC-3-13
5. Replace worn parts.	
6. Lubricate motor bearings.	
7. Replace in case, test for correct speed.	

METHOD OF EVALUATION:

1. Instructor will use speed strobe disc to check speed and listen to tape standard.
2. Evaluate procedure and check time required to complete repairs.

JOB: Troubleshoot Public Address Systems

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-4

DRAWING NUMBER: Sams Photofacts

MATERIAL:
- Tubes
- Resistors
- Transistors
- Speakers
- Capacitors
- Solder

EQUIPMENT:
- Audio signal generator
- Volt meter
- Signal tracer
- Ohm meter

TOOLS:
- Hand tools
- Nut drivers
- Long nose pliers
- Solder gun

SAFETY PRECAUTIONS:

1. Do not work in wet areas with A.C. power turned on.
2. Use isolation tranformer if needed.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Perform visual inspection.	. SC-3-1
2. Check connections, microphone, speakers, etc.	. SC-3-2
3. Test tubes/transistors.	. SC-3-15
4. Locate defective stage.	. SC-3-16
5. Check B+ and voltages.	
6. Check components.	
7. Replace defective component.	
8. Make necessary repairs as a result of the checking operations performed.	

METHOD OF EVALUATION:

1. Test for feedback from microphones.
2. Test for treble and bass response.
3. Evaluate procedure and time required to complete repairs.

JOB: Troubleshoot FM Stereo Tuner

UNIT III. AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-5

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Coils, Capacitors, Resistors

EQUIPMENT: FM Stereo Signal Generator W/RF probe, Signal tracer, Scope

TOOLS: Long nose pliers, Hand tools, Solder gun, Nut driver set

SAFETY PRECAUTIONS:

Use isolation transformer for A.C.line operated receivers.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test tubes or transistors.	. SC-3-5
2. Insert RF signal at antenna input.	. SC-3-6
3. Signal-inject RF signal at mixer.	. SC-3-8
4. Signal-inject RF signal at IF stage.	. SC-3-17 through SC-3-20
5. Signal-inject IF at detector stage.	
6. Test local oscillator stage.	
7. Make necessary repairs as a result of the testing operations.	

METHOD OF EVALUATION:

1. Test for stereo separation and on-the-air performance.
2. Evaluate procedure and clock time required to complete repairs.

JOB: Align AM Radios

UNIT III: AM, FM and Audio Systems Analysis Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Tubes Transistors

EQUIPMENT: RF signal generator Volt meter
Ohm meter

TOOLS: Hand tools Long nose pliers
Solder gun Nut drivers
Hex alignment tool

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-6

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Use isolation transformer for A.C. line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert IF signal at mixer stage.	. SC-3-6
2. Connect meter at detector output.	. SC-3-7
3. Set signal generator for 445 KC with modulated tone.	. SC-3-8
4. Peak IF transformer slugs for maximum meter reading.	
5. Reduce signal generator output and realign IF transformer slugs for maximum output.	
6. Insert RF signal at antenna input and adjust to high end of band.	
7. Adjust trimmer capacitor for maximum output.	
8. Adjust signal generator for low end of band and adjust the oscillator coil for maximum meter reading.	
9. Adjust RF signal generators for 1100 KC.	
10. Adjust receiver antenna trimmer for maximum reading on capacitor.	

METHOD OF EVALUATION:

1. Evaluate procedure performed.
2. Check receiver for reception.
3. Check receiver for fidelity.

JOB: Analyze a Radio Receiver Using the Radio Analyst

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-7

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Coils, Capacitors

EQUIPMENT: B & K Radio analyst #970 or equivalent
Cables

TOOLS: Hand tools, Solder gun, Nut drivers

SAFETY PRECAUTIONS:

Use isolation AC transformer with line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert audio signal from analyst at volume control.	. SC-3-3
2. Insert audio signal at output.	. SC-3-4
3. Insert IF signal at detector.	. SC-3-8
4. Insert IF signal at IF input.	
5. Insert RF signal at RF stage.	
6. Insert RF signal at out input.	
7. Locate defective stage from the above procedure.	

METHOD OF EVALUATION:

Evaluate procedure and have student submit shop report showing sequential procedure.

JOB: Trace Audio Signals

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-8

DRAWING NUMBER: Sams Photofacts

MATERIAL:
- Tubes
- Transistors
- Resistors
- Inductors
- Solder
- Flux
- Capacitors

EQUIPMENT:
- Signal tracer
- Volt meter
- Audio generator
- Oscilloscope
- Ohm meter

SAFETY PRECAUTIONS:

Meters set on highest scale. Use isolation transformer on A.C.line operated sets.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert audio signal at amplifier input.	. SC-3-1
2. Using signal tracer, put probe on 1st grid, then 1st plate.	. SC-3-2
3. Using signal tracer, put probe on driver grid, then driver plate.	. SC-3-4
4. Using signal tracer, put probe on output grid, then output plate.	
5. Locate defective stage by checking input and comparing to output of same stage.	
6. The same steps 1 through 5 can be used by looking at the signal on the CRT of an "oscope."	
7. Make repairs as needed by above method.	

METHOD OF EVALUATION:

1. Instructor will insert square wave and observe oscilloscope at various points.
2. Evaluate time needed for repairs.

JOB: Trace RF Signals

UNIT III: AM, FM, And Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-9

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Capacitors, Solder, Resistors, Flux, Inductors

EQUIPMENT: Signal tracer, RF generator, Ohm meter, Oscilloscope, Volt meter

TOOLS: Diagonal cutters, Soldering tools, Long nose pliers

SAFETY PRECAUTIONS:

Meters set on highest scale. Use isolation transformer on A.C. line operated set.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert RF signal at antenna input and probe the 1st grid at 1st stage. 2. Put probe at 1st stage plate. 3. Put probe at 2nd grid input. 4. Put probe at 2nd stage plate. 5. Locate defective stage by above procedure.	. SC-3-5 . SC-3-18 . SC-3-17 NOTE: Steps could be done with an RF detector probe on the oscilloscope.

METHOD OF EVALUATION:

Instructor will check stages for gain and evaluate time needed locating defective stages.

JOB: Troubleshoot AM Radios

UNIT III: AM, FM, and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-10

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Capacitors, Solder, Resistors, Inductors, Flux

EQUIPMENT: Signal tracer, RF generator, Ohm meter, Oscilloscope, Volt meter

TOOLS: Diagonal cutters, Soldering tools, Long nose pliers

SAFETY PRECAUTIONS:

Use isolation transformer on A.C.line operated units. Meters on highest scale.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Perform visual inspection.	. SC-3-4
2. Apply power (AC 1174).	. SC-3-5
3. Inject signal at volume control.	. SC-3-8
4. Signal-trace audio preamp.	
5. Signal-trace audio output.	
6. Inject RF signal with tone at antenna.	
7. Signal-trace RF stage.	
8. Signal-trace IF stage.	
9. Signal-trace detector stage.	
10. Check local oscillator stage.	
11. Make necessary repairs to defective stage.	

METHOD OF EVALUATION:

1. Instructor will test radio performance.
2. Evaluate procedures used and time required to make repairs.

JOB: Align FM Receivers

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-11

DRAWING NUMBER: Sams Photofacts

MATERIAL: Transistors, Tubes, Resistors, Capacitors, Inductors, Solder, Flux

EQUIPMENT: RF generator, Oscilloscope, Volt meters

TOOLS: Alignment tools, Long nose pliers, Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer for AC line operated sets.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up generator to radio.	. SC-3-18
2. Hook up oscilloscope to receiver.	. SC-3-19
3. Install bias if required.	
4. Adjust IF coils for proper response on oscilloscope.	
5. Repeat adjustment from first and second IF coils until maximum response and proper curve is obtained.	
6. Adjust RF for proper tracking.	
7. Adjust local oscillator for proper tracking.	
8. Disconnect equipment.	
9. Give on-air reception list.	

METHOD OF EVALUATION:

Instructor will observe alignment curve on oscilloscope and evaluate time needed for alignment.

JOB: Troubleshoot Auto Electronic Sound Equipment

UNIT III: AM, FM, and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-12

DRAWING NUMBER: Sams Photofacts

MATERIAL: Transistors, Tubes, Resistors, Capacitors, Solder, Flux, Inductors

EQUIPMENT: Signal tracer, Signal generator, Oscilloscope

TOOLS: Screwdrivers, Nut drivers, Pliers, Wrench

SAFETY PRECAUTIONS:

Engage automobile parking brake.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check wiring connections.	. SC-3-22
2. Check 12-14 VDC power input.	. SC-3-23
3. Check speaker connections.	. J-3-3
4. Check speaker or speakers.	. J-3-5
5. Check antenna.	. J-3-7
6. Remove equipment from car dash.	
7. Hook-up on bench and signal trace.	

METHOD OF EVALUATION:

Instructor will evaluate troubleshooting methods and time for repairs.

JOB: Align FM Stereo Equipment

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Transistors, Tubes, Resistors, Capacitors, Inductors, Solder, Flux

EQUIPMENT: FM generator, Oscilloscope, Meters

TOOLS: Alignment tools (hex and screwdriver type)

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-13

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Use an isolation transformer will all AC line equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up equipment to FM stereo.	. SC-3-8
2. Adjust first and second IF coils for maximum response on scope.	. SC-3-18
3. Adjust limiter circuit as per service literature for specific unit to be aligned.	. SC-3-20 . SC-3-19
4. Adjust 19Kc pilot coil for phase and amplitude.	
5. Adjust 38 Kc coil for phase and amplitude.	
6. Adjust the SCA trap for minimum response.	
7. Set the internal stereo balance control for best separation.	

METHOD OF EVALUATION:

1. Instructor will observe "S" curve on oscilloscope.
2. Observe alignment method and time required.

JOB: Set Up and Adjust Black and White Television Receiver

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

EQUIPMENT: TV Receiver

TOOLS: Screwdrivers, Pliers, Wrenches, Nut drivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-1

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Handle with care.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Unpack set from carton or crate.	. SC-4-3
2. Check for damage.	
3. Connect antenna.	
4. Plug in power cord.	
5. Tune in strong station.	
6. Adjust brightness and all customer controls.	
7. Adjust SGC control.	
8. Instruct customer how to operate TV receiver properly.	

METHOD OF EVALUATION:

1. Observe work and safety habits.
2. Evaluate sequence of work.
3. Evaluate set operation.
4. Evaluate customer briefing.

JOB: Replace a Black and White Picture Tube

UNIT IV: Television and Audio Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

EQUIPMENT: Kinescope
TV Receiver

TOOLS: Screwdrivers Nut drivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-2

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

1. Wear goggles.
2. Discharge high voltage to chassis.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Disconnect AC power.	. SC-4-1
2. Remove back.	. SC-4-2
3. Discharge high voltage on CRT to chassis.	. SC-4-3
4. Remove chassis.	
5. Lay receiver on padded surface, face down.	
6. Remove deflection yoke.	
7. Remove CRT mounting hardward.	
8. Remove CRT with caution (handle tube by bottom of bottle, not neck.)	
9. Remove new tube from carton.	
10. Insert in TV case and mount.	
11. Install yoke and chassis; apply power.	
12. Adjust yoke, width and vertical control.	
13. Put back on set.	

METHOD OF EVALUATION:

Instructor will observe methods, safety precautions, work habits, and time needed to complete CRT change over.

JOB: Repair TV Low Voltage Power Supplies

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-3

DRAWING NUMBER: Sams Photofacts

MATERIAL: Transistors, Tubes, Capacitors, Resistors, Solder, Flux, Inductors

EQUIPMENT: Volt meter, Ohm meter, Shunt capacitor, Repair parts

TOOLS: Pliers, Solder tools, Diagonal cutters

SAFETY PRECAUTIONS:

1. Use isolation transformer on all AC line operated units.
2. Set meters on highest range to start.
3. Discharge filter capacitors.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the power tubes or diodes.	. SC-4-4
2. Check the circuit breaker.	. SC-4-5
3. Check the filter capacitors for open or short.	. SC-4-6
4. Check the surge resistor for open.	
5. Check the filter choke for open or short.	
6. Check for defective connections on the boards.	
7. Check for open or shorted transformer winding.	
8. Make the necessary repairs as a result of the checking operations.	

METHOD OF EVALUATION:

Instructor will measure voltages, observe solder techniques and time needed to correct defects.

JOB: Repair Television High Voltage Power Supplies

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-4A

DRAWING NUMBER: Sams Photofacts

MATERIAL:

Transistors	Tubes	
Resistors	Capacitors	High voltage wire
Inductors	Solder	Flux

EQUIPMENT: High voltage meter, Ohm meter

TOOLS:

Solder tools	Repair parts
Nut drivers	Pliers
Diagonal cutters	Screwdrivers

SAFETY PRECAUTIONS:

Discharge high voltage anode on CRT to chassis before attempting repairs.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the high voltage tube. (Substitution method)	. SC-4-7 through SC-4-11
2. Check for open fly-back transformer.	. SC-4-36
3. Check for corona path to ground. (insulator leaks)	
4. Check for bad connections.	
5. Make the necessary repairs as a result of the checking operations performed.	

METHOD OF EVALUATION:

1. Instructor will measure CRT anode voltages with high voltage meter.
2. Instructor will check solder connections, observe time required to complete repairs.

JOB: Repair Television High Voltage Supplies Regulated System

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-4B

DRAWING NUMBER: Sams Photofacts

MATERIAL:

Transistors	Tubes	
Capacitors	Resistors	
Solder	Flux	Inductors

EQUIPMENT:
High voltage probe for VTVM
Volt meter
Ohm meter

TOOLS:

Solder iron	Pliers	
Diagonal cutters	Solder	Solder aid

SAFETY PRECAUTIONS:

Discharge high voltage anode on CRT to chassis before attempting repairs.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the high voltage tube. (Substitution method)	. SC-4-7 through SC-4-11
2. Check for the correct voltage on the tube grid.	. SC-4-36
3. Check for open grid to cathode resistor (1000 ohms).	
4. Check for insulator leaks to ground.	
5. Check for good solder joints.	
6. Make the necessary repairs as a result of the checking operations performed.	

METHOD OF EVALUATION:

1. Instructor will measure CRT anode voltages with high voltage meter.
2. Instructor will check solder connections, observe time required to complete repairs.

JOB: Repair Television Tuners

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-5

DRAWING NUMBER: Sams Photofacts

MATERIAL: Transistors, Tubes, Capacitors, Resistors, Solder, Flux, Inductors

EQUIPMENT: Bench jig, Volt meter, Ohm meter, Signal generator, Scope

TOOLS: Solder iron, Solder aid, Pliers, Diagonal cutters

SAFETY PRECAUTIONS:

Use isolator transformer on all AC line operated units.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the tubes in the tuner.	. SC-4-12 through SC-4-15
2. Check the B+ going to the tuner.	
3. Check for open plate resistors in the B+ line.	
4. Check for open balun coils.	
5. Check for open IF output transformer.	
6. Check for shorted IF output transformer.	
7. Check for excessive AGC voltages at RF grid.	
8. Make necessary repairs as result of the checking operations.	

METHOD OF EVALUATION:

1. Instructor will check all channels for off-the-air performance.
2. Evaluate time needed to correct defects.

JOB: Repair Video Amplifiers (IF Stages)

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-6A

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Solder, Resistors, Capacitors, Flux, Inductors

EQUIPMENT: Bench jig, Ohm meter, Scope, Volt meter, Signal generator

TOOLS: Solder tools, Pliers, Diagonal cutters

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the first video amplifier tube.	. SC-4-16
2. Check for B+ on the plate and screen grid.	. SC-4-33
3. Check for signal at the control grid.	
4. Check the contrast control for open.	
5. Check for open or shorted cathode capacitor.	
6. Check for open feed-through capacitor in the plate.	
7. Check for defective connections.	
8. Make the necessary repairs as a result of the checking operations performed.	

METHOD OF EVALUATION:

1. Instructor will observe definition of video quality.
2. Evaluate time needed to make repairs.

JOB: Repair Video Amplifiers (Output Stage)

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-6B

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Capacitors, Resistors, Inductors, Solder, Flux

EQUIPMENT: Bench jig, Volt meter, Ohm meter, Signal generator, Scope

TOOLS: Solder tools, Diagonal cutters, Pliers, Jump capacitor

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the video output tube.	. SC-4-16
2. Check for B+ at the plate and screen grid.	. SC-4-33
3. Check for proper input signal at the control grid.	
4. Check for open cathode resistor.	
5. Check for delay line open.	
6. Check for shorted cathode capacitor.	
7. Check for defective connections.	
8. Check for open video output transformer.	
9. Make the necessary repairs as a result of the checking operations.	

METHOD OF EVALUATION:

1. Instructor will observe definition of video quality.
2. Evaluate time needed to make repairs.

JOB: Repair Video Detectors

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-7

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Capacitors, Solder, Flux, Inductors

EQUIPMENT: Bench jig, Volt meter, Ohm meter, Signal generator, Scope

TOOLS: Solder iron, Solder aid, Pliers, Diagonal cutters

SAFETY PRECAUTIONS:

Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the detector tube on crystal diode.	. SC-4-16
2. Check load resistor for open.	. SC-4-31
3. Check for connections on printed circuit.	. SC-4-33
4. Check for detector transformer winding open.	
5. Check for open by-pass capacitors.	
6. Make the necessary repairs as a result of the checking operations.	

METHOD OF EVALUATION:

1. Instructor will observe definition of video quality.
2. Evaluate time needed to make repairs.

JOB: Repair AGC Circuits

UNIT IV: Television and Video Systems Analysis And Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-8A

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Capacitors, Solder, Flux, Inductors

EQUIPMENT: Bench jig, Volt meter, Ohm meter, Signal generator, Scope

TOOLS: Solder iron, Solder aid, Jump leads, Pliers, Diagonal cutters, Test leads

SAFETY PRECAUTIONS:

1. Meters set on highest voltage.
2. Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test AGC tube.	. SC-4-17
2. Check for horizontal pulse at plate of tube.	. SC-4-18
3. Check for B+ voltage at screen grid.	
4. Check for bias at the control grid.	
5. Check for resistor value increase on grids.	
6. Check for defective connections.	
7. Check AGC filter capacitor for open or short.	
8. Check AGC filter resistors for value change.	
9. Make necessary repairs as a result of the checking operations.	

METHOD OF EVALUATION:

1. Instructor will observe operation of AGC controls.
2. Evaluate time needed for repairs.

JOB: Repair AGC Circuits (Delay and RF)

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-8B

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Capacitors, Inductors, Solder, Flux

EQUIPMENT: Bench jig, Volt meter, Ohm meter, Signal generator, Scope

TOOLS: Solder iron, Solder aid, Pliers, Diagonal cutters, Test leads, Jump leads

SAFETY PRECAUTIONS:

1. Meters set on highest voltage.
2. Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test AGC delay diode.	. SC-4-17
2. Check filter capacitor in delay line.	. SC-4-18
3. Check filter resistor for change of value.	
4. Check for defective connections.	
5. Make necessary repairs as a result of the checking operations.	

METHOD OF EVALUATION:

1. Instructor will observe operation of AGC controls.
2. Evaluate time needed for repairs.

JOB: Repair Sync Circuits

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-9

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Capacitors

EQUIPMENT: Meters, B & K Analyst or equivalent, Scope

TOOLS: Long nose pliers, Diagonal cutters, Nut drivers, Screwdrivers

SAFETY PRECAUTIONS:

Use isolation transformer on all AC line equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test sync tube or transistor.	. SC-4-19
2. Measure B+ on plate or transistor.	. SC-4-20
3. Observe and measure video output waves with scope.	. SC-4-23
4. Measure horizontal keying with scope.	. SC-4-29
5. Check cathode resistors and capacitors.	
6. Make necessary repairs as a result of testing operations.	

METHOD OF EVALUATION:

Instructor will observe sync pulses on oscilloscope and evaluate methods, procedures and time needed.

JOB: Repair Sweep Circuits

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-10A

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Resistors, Capacitors, Solder, Flux, Inductors

EQUIPMENT: Scope, Volt meter, Ohm meter, Jump socket for JE6, B & K Analyst or equivalent

TOOLS: Test leads, Pliers, Solder tools

SAFETY PRECAUTIONS:

1. Discharge CRT anode to chassis.
2. Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test horizontal and damper tubes at the same time. (Do this by the substitution method.)	. SC-4-25 through SC-4-29 . SC-4-36
2. Check the B+ resistors to the screen grid for open.	
3. Check the by-pass capacitor for open.	
4. Check for grid drive (about 50 volts DC).	
5. Check for open cathode resistor.	
6. Check for shorted fly-back winding.	
7. Check for connections at damper socket.	
8. Check for B+ at the damper plate.	
9. Make the necessary repairs as a result of the checking.	

METHOD OF EVALUATION:

1. Instructor will observe drive waves on oscilloscope.
2. Observe time needed for repairs.

JOB: Repair Sweep Circuits Oscillator and AFC Stages

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-10B

DRAWING NUMBER: Sams Photofacts

MATERIAL:
- Tubes
- Resistors
- Solder
- Transistors
- Capacitors
- Flux
- Inductors

EQUIPMENT:
- Volt meter
- Scope
- Signal generator
- Ohm meter
- B & K analyst or equivalent

TOOLS:
- Solder tools
- Diagonal cutters
- Pliers

SAFETY PRECAUTIONS:

1. Discharge CRT anode to chassis.
2. Use isolation transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the horizontal tube.	. SC-4-26 through SC-4-29
2. Check the AFC dual diode.	. SC-4-36
3. Check the BT to the screen of the tube.	
4. Check for BT at the plate of tube.	
5. Check for shorted feed through capacitor (plate to grid).	
6. Check for correct feedback from transformer.	
7. Check for horizontal coil for open or short.	
8. Check for defective connections.	
9. Check for correct frequency of oscillator.	
10. Check for cathode resistor open.	

METHOD OF EVALUATION:

1. Instructor will observe drive waves on oscilloscope.
2. Observe time needed for repairs.

JOB: Operate TV Analyst (RF Output)

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

EQUIPMENT: B & K Analyst 1077 or equivalent
Color Receiver

TOOLS: Small hand tools Nut drivers
Pliers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-11

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Use isolation transformer on all line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up RF output cable from TV analyst to antenna of TV.	. SC-4-31 through SC-4-34
2. Adjust receiver for channel and the same channel on the TV analyst.	
3. Adjust the video on the TV analyst for proper contrast.	
4. Adjust the RF output level of the TV analyst for normal reception (1000 Micro-volts).	
5. Change channel on the receiver and on the TV analyst.	
6. Observe gain of all the channels checked.	
7. Make note of improper operation of the TV receiver.	

METHOD OF EVALUTION:

Instructor will check on-the-air performance of receiver.

JOB: Perform a Sweep Alignment

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Tubes Transistors

EQUIPMENT: Sweep generator Oscilloscope
Volt meter

TOOLS: Hex and flat blade alignment tools

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-12

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

1. Set the meters on the highest scale to start.
2. Use isolation transformer on all line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Get service literature for alignment.	. SC-4-37 through SC-4-40
2. Hook up equipment as per literature.	. SC-4-43
3. Adjust all traps as per literature.	
4. Adjust all IF transformer slugs for proper overall IF response curve.	
5. Repeat all trap adjustments with highest generator output.	
6. Repeat all IF transformer slug adjustments using the lowest generator output.	
7. Adjust sweep curve to match that required by service literature.	

METHOD OF EVALUATION:

1. Instructor will observe procedure and time required to complete alignment.
2. Instructor will compare the sweep curve on the scope to that required one in it.

JOB: Test for High Voltage

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-13

DRAWING NUMBER: Sams Photofacts

EQUIPMENT: High voltage meter Neon lamp tester

TOOLS: Screwdriver Nut drivers
Pliers

SAFETY PRECAUTIONS:

1. Arc High voltage only to chassis.
2. Use isolation on all AC line operated equipment.
3. Perform all work with extreme care.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open high voltage cage with receiver turned off.	. SC 4-7 through SC-4-11
2. Install jump cord if needed.	
3. Apply power to the set.	
4. Hold neon tester in area of high voltage probe.	
5. Check voltage with high voltage probe.	
6. Arc high voltage lead to chassis.	

METHOD OF EVALUATION:

Instructor will observe the student in the procedure of the work.

JOB: Clean Chassis and Touch-up Cabinet

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Cleaning Solution, Polish, Cabinet Touch-up kit

EQUIPMENT: Solder iron, TV receiver, Air Hose, Vacuum

TOOLS: Small hand tools, Nut drivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-14

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Work in well ventilated area.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove chassis from the cabinet.	. SC-4-14
2. Blow dust from the chassis.	
3. Wash extra dirty areas with wash solution.	
4. Melt wax from cabinet kit into deep cuts and scratches.	
5. Polish over the area with the correct color polish.	
6. On second coat of polish cover all areas around scratches.	
7. Reinstall the chassis into the cabinet.	

METHOD OF EVALUATION:

Instructor will examine finished cabinet repairs.

JOB: Repair Chroma Circuits

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-15

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes, Transistors, Capacitor, Coils, Resistors

EQUIPMENT: Volt meter, Color generator, Scope, B & K TV analyst

TOOLS: Diagonal cutters, Long nose pliers, Nut drivers

SAFETY PRECAUTIONS:

Use isolation on all AC line operated units.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the 3.58 mc Tube/Transistor.	. SC-4-41 through SC-4-45
2. Check the color crystal.	
3. Check the reactance coil for frequency.	
4. Check for B+ voltage.	
5. Check for open transformer in oscillator plate.	
6. Test the burst amplifier tube.	
7. Test the bandpass amplifier tube.	
8. Test the color killer tube.	
9. Test the demodulator tube.	
10. Check all coils for open in chroma circuit.	
11. Check for open board connections.	

METHOD OF EVALUATION:

1. Teacher will observe procedures.
2. Teacher will compare color bars on screen of repaired receiver.

JOB: Replace a Color Picture Tube

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Color CRT

EQUIPMENT: Color receiver

TOOLS: Small hand tools Nut drivers
Screwdrivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-16

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

1. Discharge high voltage before removing tube.
2. Wear safety goggles.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove back cover.	. SC-4-1
2. Remove chassis from case.	. SC-4-46
3. Remove color yoke and purity ring and blue lateral magnet.	
4. Remove deflection yoke.	
5. Lay set face down on pad and release and remove screws in mounting strap.	
6. Remove CRT from cabinet.	
7. Place new tube into cabinet.	
8. Replace mounting strap and screw tight.	CAUTION: Do not overtighten.
9. Replace deflection yoke.	
10. Replace color yoke and purity ring and blue magnet.	
11. Replace chassis in cabinet.	

METHOD OF EVALUATION:

Instructor will observe the students while handline CRT and check the time required to complete operation.

JOB: Determine Purity and Tracking of a Color Picture Tube

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-17

DRAWING NUMBER: Sams Photofacts

EQUIPMENT: Color receiver, Degaussing coil, DOT generator, Jump cables

TOOLS: Nut drivers, Screwdrivers, Mirror

SAFETY PRECAUTIONS:

1. Handle yoke with caution while set is turned on.
2. Do not tighten clamps on neck of tube too firmly.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn on receiver.	. SC-4- 1
2. Observe picture for color contamination.	. SC-4-35
3. Remove back cover.	. SC-4-38
4. Degauss color tube.	. SC-4-51
5. Adjust high voltage.	
6. Adjust static convergence.	
7. Set service switch to raster.	
8. Turn blue and green screens down.	
9. Turn red screen up.	
10. Turn purity ring on neck of tube for best pure red in center part of screen.	
11. Move yoke back and forth for perfect overall purity of red.	
12. Turn red screen down and blue and green screen up to check for neck cut-off.	

METHOD OF EVALUATION:

1. Instructor will observe the red screen and the purity of the white screen.
2. Procedures will be evaluated.

JOB: Perform Convergence Alignment

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

EQUIPMENT: Color TV receiver, Color bar generator, Dot generator

TOOLS: Alignment tools, Mirror, Nut drivers, Screwdrivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-18

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Observe caution when working on the neck of the picture tube.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove back cover.	. SC-4-38
2. Hook up generator to antenna connections.	. SC-4-41
3. Turn on receiver and generator and allow a 15 minute warm-up time.	
4. Check purity of CRT.	
5. Adjust static controls for center of screen, red and green.	
6. Adjust vertical controls for vertical bar in the center of the screen (red and green screen on only).	
7. Adjust, while watching top and bottom.	
8. Adjust vertical line adjustment for top horizontal line and bottom horizontal line (red and green).	
9. Adjust horizontal controls for horizontal line in center of screen.	
10. Adjust horizontal lines left and right side of the screen.	
11. Turn up blue screen and adjust blue controls to make blue lines converge with the red and green.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
12. Re-adjust the static controls if needed. 13. Repeat steps 5 through 12 for finer convergence alignment. 14. Check CRT color temperature .	

METHOD OF EVALUATION:

Instructor will check the dot pattern on the CRT when student is finished with the alignment.

JOB: Align Television Sound Circuits

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

MATERIAL: Tubes Transistors

EQUIPMENT: B & K 415 Sweep generator
TV Receiver

TOOLS: Alignment tools Screwdrivers
Nut drivers

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-19

DRAWING NUMBER: Sams Photofacts

SAFETY PRECAUTIONS:

Use isolation transformers on AC line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove chassis from cabinet.	. SC-4-39
2. Hook up to bench jig.	
3. Allow warm-up time of 15 minutes.	
4. Hook up alignment generator for video and sound IF sweep.	
5. Modulate a 4,5 MC signal and apply to sound take off coil.	
6. Adjust the IF coils for maximum output at the speaker.	
7. Remove the signal from the generator.	
8. Tune in local strong TV station.	
9. Adjust the Quad coil for lowest buzz possible.	

METHOD OF EVALUATION:

Instructor will check for the best possible sound from the station on the air, both local and distant stations.

JOB: Align Chroma Circuits

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-20

DRAWING NUMBER: Sams Photofacts

MATERIAL: Tubes Transistors

EQUIPMENT: TV Receiver Sweep generator with chroma B & K 415

TOOLS: Alignment tools Screwdrivers

SAFETY PRECAUTIONS:

Use isolation on all AC line operated equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up chassis to bench jig.	. SC-4-38 through SC-4-40
2. Hook up generator to TV set.	. SC-4-43
3. Check IF alignment.	
4. Inject chroma 3.58 mc signal to the chroma take-off stage.	
5. Adjust the band pass transformer for correct sweep and frequency of markers.	
6. Adjust the take-off coil for correct frequency.	
7. Re-adjust the band pass coils at the lowest possible generator signal.	
8. Disconnect the signals and adjust the sync circuit for color sync.	
9. Repeat all of the above adjustments as required by the service literature for the receiver under the set up.	

METHOD OF EVALUATION:

Instructor will check with the color bars for correct color and observe off the air reception of the color signal.

JOB: Perform a Bench Repair Using a Test CRT

UNIT IV: Television and Video Systems Analysis and Troubleshooting

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-21

DRAWING NUMBER: Sams Photofacts

EQUIPMENT: Test CRT and Cables
High voltage cable
Volt meter
Ohm meter
B & K analyst

SAFETY PRECAUTIONS:

1. Use an insulator at the high-voltage connection.
2. Use isolation on all AC line operated equipment.
3. Ground the CRT Dag to the chassis.
4. Instructor will check for correct hook-up before the student may apply power to the test set-up.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up CRT cable to CRT and chassis.	. SC-4-1
2. Hook up yoke and convergence cables to CRT and TV chassis.	. SC-4-47
3. Adjust the temperature of the CRT.	. SC-4-49
4. Adjust the static convergence.	. SC-4-50
5. Proceed with the troubleshooting.	
6. Remove the cables from all the chassis points.	
7. Discharge the high voltage from the CRT.	
8. Remove the chassis from the bench.	

METHOD OF EVALUATION:

Instructor will check procedure, time for job and quality of finished work.

JOB: Install and Adjust a Television Receiver

UNIT V: Systems Maintenance, Repair, and Performance Analysis

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-1

COURSE: Radio and Television Repair

EQUIPMENT: Operating Monochrome Television Receiver
Operating Color Television Receiver
Antenna outlet
A.C.supply outlet
Color bar generator
Color hatch generator

TOOLS: Plier type tools
Screwdrivers
Tuning wands
Assorted nut drivers
Mirror

SAFETY PRECAUTIONS:

For shop instruction, isolate A.C.power supply.
CAUTION: Students should be made aware of non-isolation of A.C.power in consumer's home. Students should be made aware of safe handling precautions.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Antenna must be connected to monochrome receiver.	NOTE: On all receivers except small portables, two people should be used to transport from one area to another.
2. Connect monochrome receiver into isolated power supply.	. SC-4-3
3. Turn on receiver and adjust customer controls for normal operation.	. SC-4-17
4. Check pix for vertical and horizontal centering, size, linearity, and focus. Adjust as necessary.	. SC-4-21
5. Adjust AGC if necessary.	. SC-4-26
6. Instruct customer on customer controls.	. SC-4-47 through SC-4-49
7. Color receiver: connect antenna, plug into A.C.power.	. SC-5-1 through SC-5-4
8. Turn on receiver and adjust for normal color reception.	
9. Turn off color, disconnect antenna, connect color bar generator, check picture for size, centering, gray scale, tracking and focus.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
10. Degauss receiver, set purity if necessary. 11. Check screen convergence with cross hatch pattern, converge if necessary. 12. Inject color bars in receiver, check hue range, adjust AGC and color killer if necessary. 13. Instruct customer on operation of color controls.	

METHOD OF EVALUATION:

1. Correct alignment sequence
2. Color separation
3. Quality of alignment

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-2

JOB: Install a Home FM and TV Antenna

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

MATERIAL:
- Mounting bracket kits
- Lead-in wire
- TV Antenna
- UHF/VHF combination
- Antenna Pole

EQUIPMENT: Simulated Chimney (for practice)

TOOLS:
- Small hand tools
- Hack saw
- Wrenches
- Tool belt

SAFETY PRECAUTIONS:

Students should be given instructions and demonstrations on safe climbing habits and safe placement of ladders.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place chimney mount loosely on simulated chimney.	. SC-1-1, SC-1-2
2. Level mount and tighten securely.	NOTE: DO NOT over-tighten.
3. Attach antenna to antenna pole. Attach lead-in wire.	. SC-1-10 . SC-5-5 through SC-5-7
4. Place pole in chimney mount and secure. Cut pole if necessary.	. SC-5-9 . SC-5-10
5. Run lead-in wire by shortest, neatest route to receiver.	. SC-5-16
6. Attach lead-in to receiver.	
7. Orient antenna.	

METHOD OF EVALUATION:

1. Visual check of installation
2. Equipment performance check

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-3

JOB: Install a MATV System

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

MATERIAL:
- MATV Amplifiers
- Antenna
- MATV Tapoffs
- MATV Connectors
- RG 59/U Coax Cable
- RG 11/U Coax Cable

EQUIPMENT:
- Field strength meter
- Ladders
- Ohm meter

TOOLS:
- Small hand tools
- Screwdrivers
- Nutdrivers

SAFETY PRECAUTIONS:

Use wooden ladders only!

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Erect antenna.	. SC-5-6
2. Measure signals.	. SC-5-7
3. Calculate longest run and calculate Db drop.	. SC-5-9 through SC-5-13
4. Draw simple layout diagram.	. SC-5-15 through SC-5-17
5. Install amplifier needed due to Db drop.	
6. Install line splitters needed.	
7. Install cable.	
8. Install tapoffs.	
9. Measure signal at TV outlet.	
10. Adjust amplifier as required for balanced signals at all outlets.	

METHOD OF EVALUATION:

Instructor will measure signals available at outlets with field strength meter and check connections to fittings.

JOB: Install a Closed Circuit RF Distribution System

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-4

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

MATERIAL: Tapoffs, Amplifiers, Connectors, RG 59/U Cable, RG 11/U Cable

EQUIPMENT: Field strength meter, Ohm meter

TOOLS: Small hand tools, Nut drivers, Crimping tool - 59/11, Screwdrivers

SAFETY PRECAUTIONS:

Use wooden ladders only!

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install head end equipment.	. SC-5-9 through SC-5-13
2. Calculate longest run of cable and estimate Db drop.	. SC-5-15 through SC-5-17
3. Draw simple layout diagram.	
4. Install amplifier needed due to Db drop.	
5. Install line splitters needed.	
6. Install tapoffs needed.	
7. Measure signal at outlet.	
8. Adjust amplifier as required to balance signals at all outlets.	

METHOD OF EVALUATION:

Instructor will measure signals available at outlets with field strength meter and check connections and fittings for correct installation.

JOB: Install a Home Music and Intercom System

JOB SHEET IDENTIFICATION CODE

UNIT V: Systems Maintenance, Repair, and Performance Analysis

JOB NUMBER: J-5-5

COURSE: Radio and Television Repair

MATERIAL: Wire
Master Drawing

EQUIPMENT: Speakers with enclosures
Operating RF-Multi Channel Audio Unit
VOM

TOOLS: Small hand tools Power drill

SAFETY PRECAUTIONS:

1. Use safety glasses for drill operation.
2. Use isolated A.C.power supply in shop.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Practice survey for installation of master unit and speakers.	. SC-5-9
2. Draw pictorial layout of practice installation.	. SC-5-31 . SC-5-32
3. Install master unit in assigned area.	. SC-1-1
4. Install speakers at remote locations with enclosures.	. SC-1-2 . SC-1-4
5. Connect master system to speakers.	. SC-1-6
6. Check out complete system.	. SC-1-10
7. Simulate customer instruction.	

METHOD OF EVALUATION:

Instructor will inspect and evaluate physical appearance and overall performance of system.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-6

JOB: Service and Repair MATV System

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

MATERIAL: Coax cable, Transistors, Tubes, Tapoffs

EQUIPMENT: Field strength meter, Volt meter, Ladder, Ohm meter

TOOLS: Small hand tools, Screwdrivers, Crimping tool, Diagonal cutters

SAFETY PRECAUTIONS:

Use wooden ladders only!

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure outlet signals.	. SC-5-9 through SC-5-13
2. Measure amplifier output.	. SC-5-15 through SC-5-17
3. Measure line splitter output.	
4. Localize trouble.	
5. Correct defective unit.	
6. Measure outlet signal.	
7. Balance and adjust line amplifier as required for proper signal output.	

METHOD OF EVALUATION:

Instructor will measure signal at outlet and check quality of a monitor signal.

JOB: Service and Repair a Video Distribution System

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-7

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

MATERIAL:
- Coax cable
- Tube
- Connectors
- Transistors
- Tapoffs
- Resistors
- Capacitors

EQUIPMENT:
- Video monitor
- Volt meter
- Ohm meter
- VU meter

TOOLS:
- Small hand tools
- Diagonal cutters
- Solder gun
- Solder aids
- Pliers

SAFETY PRECAUTIONS:

Use isolated A.C. power on all units.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure outlet signal.	. SC-5-9 through SC-5-13
2. Measure amplifier output.	. SC-5-15 through SC-5-17
3. Measure input signal to amplifier.	
4. Localize trouble.	
5. Correct defective unit.	
6. Measure outlet signal.	
7. Balance and adjust line amplifier.	
8. Recheck outlet signal.	

METHOD OF EVALUATION:

Instructor will measure signal at outlet and check video and sound quality at a monitor.

JOB: Service and Repair a Home Music and Intercom System

JOB SHEET IDENTIFICATION CODE

UNIT V: Systems Maintenance, Repair, and Performance Analysis

JOB NUMBER: J-5-8

COURSE: Radio and Television Repair

MATERIAL: Schematic drawing of complete system

EQUIPMENT: Non-operating master intercom system (tube type) with speakers
VTVM

TOOLS: Small hand tools

SAFETY PRECAUTIONS:

Use isolated A.C.supply for power.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn on system and listen for hum in speaker. 2. Remove system from mounting area if no hum in speaker. 3. Check for A.C.power. 4. Check fuse, switch, and tubes. 5. Check wiring and speaker if only one location inoperative. 6. Remove system to shop if major repairs are necessary. 7. Repair, reinstall and check out system.	. SC-1-1 . SC-1-2 . SC-1-4 . SC-1-6 . SC-1-7 . SC-1-17 . SC-2-5 . SC-5-18 through SC-5-20 . SC-5-2

METHOD OF EVALUATION:

1. Instructor will determine adequacy of troubleshooting and repair sequence.
2. Evaluate quality of repairs.
3. Determine degree of customer satisfaction.

JOB: Install and Commercial Sound System

UNIT V: Systems Maintenance, Repair, and Performance Analysis

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-9

MATERIAL: Paper
Pencil Drawing materials

EQUIPMENT: Operating public address amplifier

TOOLS: Small tools

SAFETY PRECAUTIONS:

Use isolated A.C. power supply.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain project requirements from instructor.	. SC-5-17 . SC-5-21 . SC-5-22
2. Layout commercial sound and public address system.	. SC-1-1 . SC-1-2 . SC-1-4
3. Simulate installation of complete system.	. SC-1-10 . SC-3-15 . SC-3-16
4. Wire speakers using 70 volt line transformers.	. SC-3-3
5. Simulate speaker placement for feedback.	
6. Check system and instruct consumer on functions.	

METHOD OF EVALUATION:

1. All factors considered in equipment selection and layout.
2. Equipment installed correctly.
3. Quality of reproduction in all areas to be covered.
4. Customer satisfaction.

JOB: Service a Commercial Sound System

UNIT V: Systems Maintenance, Repair and Performance Analysis

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-10

MATERIAL: Schematic diagram

EQUIPMENT: VTVM
Signal tracer
Non-operating public address system.

TOOLS: Small hand tools
Soldering gun

SAFETY PRECAUTIONS:

Use isolated A.C. power supply.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check simulated public address system for malfunction.	. SC-1-1 . SC-1-2 . SC-1-4
2. Check master unit for defective fuse, switch and/or loose connection.	. SC-1-6 . SC-1-7 . SC-1-15
3. Check microphone.	. SC-2-6 . SC-3-2
4. Check speakers.	. SC-5-31 . SC-5-32
5. Remove system to shop for major repair if necessary.	
6. Reinstall and check out system completely.	

METHOD OF EVALUATION:

1. Instructor will determine adequacy of troubleshooting and repair sequence.
2. Evaluate quality of repairs.
3. Determine degree of customer satisfaction.

JOB: Compose and Use a Repair Order Form

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-1

MATERIAL: Ball point pen
Printed simulated repair order forms
Manufacturer repair order forms
Tube Price List
Parts and Price List Books

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine instructions on proper procedure for filling out repair order forms. 2. Practice filling out repair order forms. 3. Practice pricing parts on repair order form. 4. Give customer estimate of bill. 5. Total price and service charges. 6. Add tax charges. 7. Double check totals.	. SC-6-1 . SC-6-3 . SC-6-11 . SC-6-18

METHOD OF EVALUATION:

Applicability of form to real life experience.

JOB: Initiate Stock and Inventory Control

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

MATERIAL: Ball point pen
Stock and inventory control sheets
Tube and parts price book

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-2

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Prepare list of most commonly used tubes and parts. 2. Cost-out price of commonly used tubes and parts; record in ledger. 3. Take inventory of school shop stock of parts and record. 4. Price-out cost of school shop parts and record. 5. Estimate proper amount of parts needed for radio and television repair operation. 6. Contact local wholesale electronic supplier for correct net price of ten parts.	NOTE: This shall be preceded by lecture and discussion of need of stock and inventory control. . SC-6-4 through SC-6-8 . SC-6-13 . IL-6-4 . IL-6-5

METHOD OF EVALUATION:

Applicability of completed job to shop requirements.

JOB: Demonstrate Correct Telephone Techniques

JOB SHEET IDENTIFICATION CODE

UNIT VI: Customer Relations and Business Management

JOB NUMBER: J-6-3

COURSE: Radio and Television Repair

MATERIAL: Ball point pen
Repair order forms
Telephone message book

EQUIPMENT: Local telephone
Telephone--disconnected
Desk and chair

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Observe demonstration of telephone answering techniques.	. SC-6-1 . SC-6-2
2. Practice answering disconnected telephone and/or writing message or repair number.	. SC-6-9 through SC-6-11 . SC-6-18
3. Answer local phone to take simulated service call.	. SC-6-20
4. Answer local phone to render information on assistance pertaining to radio and television repair.	. IL-6-6

METHOD OF EVALUATION:

Correct telephone techniques in placing and receiving a telephone call.

JOB: Prepare a Plan of Cost Versus Profit

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-4

MATERIAL: Ball point pen
Debit-Credit Sheet (basic)
Information on cost of parts, utilities, truck expenses

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Talk to and inquire of business practice person on ledger guidelines. 2. Record simulated incomes under proper headings. 3. Record simulated costs and expenses under proper headings. 4. Balance cost versus profit sheets. 5. Project profit or loss of simulated repair shop.	NOTE: This should be preceded by lecture and discussion on cost versus profit ledger. . SC-6-11 . SC-6-12 thoough SC-6-17 . IL-6-9

METHOD OF EVALUATION:

Applicability of completed job to simulated business.

JOB: Demonstrate Proper Handling of Customer Complaints

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

MATERIAL: Ball point pen Message book

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-5

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Explain to the instructor the possible solutions to his problem and possible further expense.	NOTE: This should be preceded by instructor registering simulated complaint on repaired electronic item.
2. Listen to simulated irate student-customer complaint on repaired item.	. SC-6-11
3. Calm irate student-customer.	. SC-6-18
4. Explain possible avenues or options open to customer.	. SC-6-19 . SC-6-20

METHOD OF EVALUATION:

Observation of student performance

JOB: Demonstrate Acceptable Employer-Employee Communications

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-6

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Listen to local TV businessman on employee-employer relationship. 2. Submit paper on your thoughts on employee-employer relationship. 3. Practice relationship by being school shop foreman.	NOTE: This should be preceded by lecture and talk by instructor on employer relationship. . SC-6-19 through SC-6-22

METHOD OF EVALUATION:

Observation of student performance

JOB: Compile a List of Local Safety Requirements and Regulations (NEC)

UNIT VI: Customer Relations and Business Management

COURSE: Radio and Television Repair

MATERIAL: Ball point pen
Paper

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-7

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. From all sources available, compile a list of local safety requirements. 2. Write to National Electrical Association for pertinent information. 3. Submit all material to instructor for discussion.	

METHOD OF EVALUATION:

Are all important safety requirements listed?

OPERATION SHEET
SC-1-1

COMPETENCY: Use of Plier-Type Tools

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To select and use plier-type tools appropriate to the job.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sign out from tool room at least three plier-type tools. 2. Examine pliers, noting handles and jaws. 3. Pick up plier-type tool in palm of hand. 4. Keep thumb on side of one handle, other fingers wrapped partially around the handle. Keep fingers from inside of handles, while maintaining firm grip. 5. Open and close pliers while maintaining grip. 6. Using long nose type pliers, wrap at least 10 connections with care. 7. Care should be exercised, as too much pressure will damage wire. 8. Select side cutters and cut several wires of different thickness. 9. Care should be observed never to use side cutters on wire too thick, as there is danger of breaking jaws. 10. Examine and practice using all other plier types available in shop.	NOTE: Suggested types: long nose, side cutters, slip-joint.

METHOD OF EVALUATION:

1. Tool selection and inspection
2. Practice in tool use

OPERATION SHEET
SC-1-2

COMPETENCY: Use of Driver-Type Tools

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To select and use tools appropriate to the job.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sign out from tool room regular screwdriver, Phillips screwdriver, 1/4" nut driver. 2. Examine drivers, noting handle and blade. 3. Remove and replace screws from chassis assigned by instructor. Care should be taken to see that blade is firmly seated in screw before removing screw. Screws should be tightened snugly, never overtighten. Have instructor check your work for proper "feel" of tightness. 4. From same chassis, practice removing 1/4 head screws and replacing same. 5. Examine all other driver-type tools in shop. 6. Write explanation on use of other drivers and turn in to instructor.	NOTE: If blade or nut driver show sign of wear, call instructor.

METHOD OF EVALUATION:

1. Selection and inspection of tools
2. Practice in tool use

OPERATION SHEET
SC-1-3

COMPETENCY: Use and Care of Soldering Tools

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To use and care for soldering tools.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Sign out soldering gun and soldering equipment.	
2. Inspect soldering gun, noting pistol grip handle, trigger switch and heating unit.	
3. Plug soldering gun into AC power, pick up gun in hand and place index finger over trigger switch.	
4. With heating unit turned away from you, press trigger switch and observe heating unit.	NOTE: Normally, a slight puff of smoke will rise from heating unit tip at this point. Release trigger and put soldering gun safely on work bench. Keep hot tip away from all objects.
5. Obtain small file from tool room and file all tarnish off end of gun tip.	
6. Dip tip in resin paste and heat gun; apply solder to re-tin tip.	
7. Obtain soldering pencil and holder from tool room.	
8. Plug pencil into AC power and heat.	
9. Wipe hot pencil with wet sponge and apply small amount of solder and re-tin tip. Soldering pencil is now ready for use.	

METHOD OF EVALUATION:

1. Equipment inspection
2. Tinning procedures

OPERATION SHEET
SC-1-4

COMPETENCY: Apply Wiring Soldering Techniques

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To wire and solder circuit connections.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain old chassis, soldering gun, soldering pencil and necessary tools from stock room.	NOTE: Be sure to obtain soldering aid tool.
2. On open terminal strip, wire a good mechanical connection, a junction of two wires and a resistor.	
3. Press hot soldering gun tip to one side of wire connection.	
4. Apply solder to other side of connection and flow solder onto connection, using heat through connection.	
5. Remove gun and then solder from connection. Let cool.	
6. Examine connection for shiny finish, indicating a good solder connection.	

METHOD OF EVALUATION:

Student will correctly wire and solder ten connections with no cold solder joints.

OPERATION SHEET
SC-1-5

COMPETENCY: Solder Printed Circuits

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To solder components on printed circuit boards.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain practice printed circuit boards, solder pencil and necessary tools.	. SC-1-1 . SC-1-3
2. Insert component into hole in printed circuit.	
3. Firmly place hot tip of soldering pencil on component lead and printed circuit.	
4. Flow small amount of solder onto connection.	
5. Remove soldering pencil and then solder. Let cool.	
6. Examine joint for loose connection.	
7. Have instructor place break in printed circuit.	
8. Clean resin and any coating from print on both sides of break, making both sides "shiny clean."	
9. Cut piece of bare wire large enough to go over break.	
10. Tin wire while holding with long nose pliers.	
11. Place wire neatly over break, and solder across break.	
12. Visually examine for good connection.	CAUTION: Overheating will lift foil from printed board. Apply only enough heat to make solder connections and remove heat quickly. Never use over 40 watt pencil.

METHOD OF EVALUATION:

Correctly solder three components to printed circuit boards.

OPERATION SHEET
SC-1-6

COMPETENCY: Measure Resistance with a Volt-Ohm-Milliameter

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To measure resistance with a Volt-ohm-milliameter

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain 10 assorted resistors and VOM from stock room.	. IL-1-10 . IL-1-14
2. Read and record all resistor values by color code.	
3. Select correct resistance scale and with proper probes, read and record each resistor.	
4. Compare resistance read with ohmic value by color code and tolerance indicated.	CAUTION: No power applied for resistance check.
5. Obtain TV chassis and from resistance readings on schematic diagram, check resistance on TV chassis. If any differences, trace circuit and locate problem.	

METHOD OF EVALUATION:

1. Measure and record 10 assorted resistor values.
2. Compare with color code readings and explain any difference.

OPERATION SHEET
SC-1-7

COMPETENCY: Measure Voltage with a Volt-Ohm-Milliameter

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To measure voltages with a Volt-ohm-milliameter.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain operating radio or TV chassis. 2. Obtain schematic diagram for assigned chassis. 3. Set VOM or VTVM for desired scale. 4. Take voltage readings of plate voltages of several tubes. Record and compare with schematic. 5. Take B+ readings at source and record. 6. Set meter to DC scale and take grid voltage readings. Record and compare with schematic.	CAUTION: Voltage measurements must be taken with power on. All electrical safety precautions must be observed. CAUTION: Scale must be set above voltage reading given on schematic to avoid meter damage. Black lead to negative, red to positive across potential. . IL-1-1 . IL-1-3 . IL-1-6 . IL-1-13 . IL-1-14

METHOD OF EVALUATION:

1. Meter function and range selection.
2. Measure correct voltage readings from the plate and grid circuits of five tubes.

OPERATION SHEET
SC-1-8

COMPETENCY: Measure Current with a Volt-Ohm-Milliameter

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To measure current with a Volt-ohm-milliameter.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain operating TV or radio chassis. 2. Obtain schematic diagram for assigned receiver. 3. Locate cathode of horizontal output tube, or cathode of audio output tube. 4. Unsolder connection to cathode of tube. 5. Connect ammeter in series with cathode and cathode components. 6. Turn power on. Read, compare and record current measurements obtained with schematic diagram. 7. Using Ohm's Law, calculate voltage drop across cathode resistor from readings taken. If receiver has no cathode resistor, obtain one with cathode resistor. 8. Solder all connections back to cathode of output tubes.	CAUTION: Power must be on for current readings. Meter leads must be in series with circuit under test, with correct polarity. . IL-1-1 . IL-1-3 . IL-1-4 . IL-1-6 . IL-1-11 . IL-1-14

METHOD OF EVALUATION:

1. Meter function and range selection
2. Measure and record two cathode current readings on a horizontal output tube of a television receiver.

OPERATION SHEET
SC-1-9

COMPETENCY: Test Batteries

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: Test battery voltage to determine condition.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
<u>With Battery Tester</u>:	. SC-1-7
1. Set battery tester to battery voltage.	. IL-1-7
2. Connect negative probe to negative pole of battery, positive probe to positive pole.	. IL-1-14
3. Read quality of battery on meter scale. This is a reliable method as battery tester places load on battery while making test.	
<u>With Voltmeter and load</u>:	
1. Connect battery to device it powers with the switch off.	
2. Measure the no-load voltage with a FET meter or a VTVM.	
3. Turn on device and measure the battery voltage under load.	
4. If the load voltage drops more than 20% of no load voltage, the battery is defective.	

METHOD OF EVALUATION:

1. Correct use of equipment
2. Check student voltage readings.

OPERATION SHEET
SC-1-10

COMPETENCY: Use of Power Drill

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: Use an electric power drill and accessories.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inspect power drill to determine that there are no hazards--frayed cord--defective plug--open ground.	. IL-1-1
2. Use safety goggles at all times when operating power drill.	
3. Select proper bit size for hole desired.	
4. Loosen chuck--insert shank of bit all the way into chuck.	
5. Center bit in chuck--tighten chuck.	
6. Mark centerline of hole to be drilled.	
7. Center-punch this mark.	
8. With work firmly held in vise, seat bit in center-punch hole--energize drill. Start drill at low speed and gradually increase, if possible.	
9. Keep a steady, light pressure on drill as drilling progresses.	
10. After hole is drilled, remove and clean bit.	
11. Return all tools to storage place.	

METHOD OF EVALUATION:

1. Inspection of equipment
2. Selection of accessories
3. Correct use of power drill.

OPERATION SHEET
SC-1-11

COMPETENCY: Replace Component

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: Replace printed circuit board components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use a small soldering iron (30-50 watts).	. SC-1-3
2. 60/40 resin core solder should be used.	
3. Connect a heat sink between the body of all solid state components and the heat when removing or installing them on PC boards.	
4. Repair all breaks in PC board islands with a wire jumper soldered on both ends.	
5. Use a "solder sucker" pencil or copper braid multi-connection parts to remove solder.	
6. Replace components with exact or equivalent units only. Do not substitute values.	
7. Multi-connection parts that will not be reinstalled can be crushed on component side of board--the individual connections can then easily be removed one at a time.	
8. Components that are heat sinked should have the silicone grease (heat conductive coating), replenished when new unit is installed.	
9. Component leads should be pushed through mounting holes in board, bent over, soldered and then excess lead length removed.	

METHOD OF EVALUATION:

1. Equipment selection
2. Repair techniques
3. Quality control of repair

OPERATION SHEET
SC-1-12

COMPETENCY: Use a Tube Tester

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To set up a tube tester and determine operating condition of vacuum tubes.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine tube number as marked on glass envelope or base.	
2. Turn roll chart or set-up manual to this number.	
3. Set all levers, knobs, switches according to information on chart or manual. Check this set up at least once.	
4. Place tube in socket.	
5. While tube is warming, adjust line voltage compensation control.	
6. Test tube for leakage or shorts.	
7. Test tube for grid emission.	
8. Test tube for gas content.	
9. Test tube for life expectancy.	
10. Test tube for transconductance.	
11. Write up a tube report for all these tests.	

METHOD OF EVALUATION:

1. Controls set correctly
2. Accuracy of test measurements
3. Correct diagnosis

OPERATION SHEET
SC-1-13

COMPETENCY: Use a Capacitor Tester

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To determine the operating condition of capacitors by using a capacitor tester.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the capacitor of unknown value to the TEST terminals. The VOLTAGE switch is not used in this test. 2. Set the TYPE switch to its lower position. This position is for paper, mica, ceramic, glass and other small value capacitors. 3. Set the RANGE switch to C .0001 or C .01 position, depending upon capacitor size. 4. Set the BRIDGE-LEAKAGE switch to BRIDGE. 5. Adjust the BALANCE control for eye-tube opening. 6. Read value on "C" scale and multiply by the RANGE switch setting. 7. A capacitor which will not balance on any of the ranges but allows the eye to open on the low end of the low range, is an OPEN capacitor. 8. A capacitor which allows the eye to open on the high end of the high range is SHORTED.	NOTE: It is always best to connect the component under test directly to the TEST terminals. Long test leads may pick up stray AC fields and give inaccurate readings. If test leads must be used, keep them as short as possible. . IL-1-14 . IL-1-24

METHOD OF EVALUATION:

1. Controls set correctly
2. Measurements correctly interpreted

OPERATION SHEET
SC-1-14

COMPETENCY: Use a Transistor Tester

COURSE: Radio and Television Repair UNIT I: Fundamental AC and DC Electronic Theory

OBJECTIVE: To determine operating condition of transistors using a transistor tester.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove transistor from circuit. 2. Determine transistor number or equivalent number from a cross-reference chart. 3. Set the transistor tester controls according to set-up chart furnished with tester. If set-up is unavailable a comparison may be made with an identical transistor. 4. Connect the emitter, base and collector leads by means of cable or plug-in socket provided on tester. 5. Measure transistor leakage. 6. Measure transistor gain. 7. Compare test measurements with component specifications to determine condition.	CAUTION: Use a heat sink when unsoldering. NOTE: The standard prefix for American transistors is 2N. . IL-2-14 . IL-2-18

METHOD OF EVALUATION:

1. Controls set correctly
2. Transistor connected correctly.
3. Accuracy of measurements
4. Correct diagnosis.

OPERATION SHEET
SC-2-1

COMPETENCY: Measure Tube Voltages

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To develop skill in measuring component voltages at the tube socket.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Review safety lesson.	. IL-1-1
2. Set VOM to read DC volts	. SC-1-7
3. Set VOM on 0-330 volt range.	
4. Connect VOM common (black) lead to radio receiver ground.	
5. Apply power to AM radio chassis.	
6. Secure receiver schematic or tube manual to identify tube pins.	
7. Touch positive (red) probe to plate pin of tube. Record plate voltage Ep volts.	
8. Touch positive probe to screen grid pin. Record screen grid voltage Eg2 volts.	
9. Reduce voltmeter range to 0-50 volts.	
10. Measure cathode, control grid, and suppressor grid to ground voltages and record. E_k__v. E_{g1}__v. E_{g3}__v.	
11. Set VOM to read DC negative on the 0.25 volt range. Read bias -__ volts. (Grid to cathode.)	
12. Set VOM to read AC volts (0-15 range).	
13. Connect VOM across heater pins. Read heater voltage ____ volts. REMOVE POWER.	

METHOD OF EVALUATION:

Read and record all voltages on an operating radio receiver.

OPERATION SHEET
SC-2-2

COMPETENCY: Measure Tube Resistances

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To measure all resistances from tube socket to common ground.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine normal resistance readings from schematic diagram. 2. Read resistance from plate to common by connecting ohmmeter probes to plate pin and common (ground). Zero the ohmmeter before reading. 3. Read resistance from screen grid to ground. Record -- ___ ohms. 4. Read resistance from control grid to ground. Record -- ___ ohms. 5. Read resistance from cathode to ground. Record -- ___ ohms. 6. Read resistance from suppressor grid to ground. Record -- ___ ohms.	NOTE: Never have power applied when taking resistance measurements. . IL-1-9 . IL-1-12 . SC-1-6

METHOD OF EVALUATION:

Read and record all resistance readings from tube pin sockets to ground on a typical receiver.

OPERATION SHEET
SC-2-3

COMPETENCY: Measure Transistor Voltages

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To develop skill in measuring transistor electrode voltages.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Identify collector, base and emitter points, using a schematic and pictoral diagrams.	. IL-1-1 . IL-1-12
2. Energize transistor stage.	. IL-2-14
3. Set up VOM to read DC volts, either negative or positive, depending upon power supply.	. SC-1-7
4. Set meter on appropriate range to read voltage values.	
5. Connect positive (red) probe to collector, common probe to ground. Read collector voltage and record ___ volts.	
6. Similarly, read base voltage by connecting red probe to base and black probe to common. Record base voltage, V_B ___ volts.	
7. Measure emitter to grid. Record V_E ___ volts.	
8. Measure base-to-emitter voltage and record V_{BE} ___ volts.	
9. Measure collector-to-base voltage and record V_{CB} ___ volts.	
10. Measure collector-to-emitter voltage and record V_{CE} ___ volts.	

METHOD OF EVALUATION:

1. Meter set properly
2. Identification of connections
3. Meter readings

OPERATION SHEET
SC-2-4

COMPETENCY: Measure Transistor Resistances

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To measure resistance associated with a transistor stage.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine normal resistance readings from schematic diagram. 2. Set meter on suitable ohms range and connect probes from collector to common. Read the collector to common resistance. ___ ohms. 3. Measure resistance from base to ground. ___ ohms. 4. Measure resistance from emitter to ground. ___ohms.	NOTE: Meter used must apply only .08 volt or less to circuit under test, to prevent error produced when a diode or transistor junction is turned on. APPLY NO POWER. . IL-1-9 . IL-1-12 . SC-1-6

METHOD OF EVALUATION:

1. Meter set properly
2. Identification of connections
3. Meter readings

OPERATION SHEET
SC-2-5

COMPETENCY: Test a Speaker

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To test a dynamic speaker for normal output.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check for rubbing cone by gently pushing on opposite sides of speaker cone with thumbs. A rubbing or scraping feel indicates voice coil is rubbing sides of magnet assembly. Cone should move freely.	. IL-3-15 . SC-1-4 . SC-1-6
2. Check voice coil for continuity. A low resistance reading, under 25 ohms is normal. A slight click should be heard when ohmmeter is first connected to speaker voice coil. At this time, cone can be felt to move in or out.	. SC-1-11
3. Disconnect speaker from device and substitute a known good test speaker.	
4. Examine speaker cone for perforations.	
5. Examine spider for breaks.	
6. Examine tinsel leads from voice coil to speaker lead lugs for breaks or fraying.	

METHOD OF EVALUATION:

1. Visual inspection
2. Resistance readings
3. Speaker performance

OPERATION SHEET
SC-2-6

COMPETENCY: Check a Microphone

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To isolate and correct defects in microphones.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check microphone by substitution.	. IL-3-14
2. Check DYNAMIC microphone voice coil leads for continuity.	. SC-1-6
3. Check microphone switch with an ohmmeter.	. SC-1-11
4. Check mike interconnecting leads and plugs for opens and shorts with ohmmeter. Flex leads as this test is made for intermittent defect conditions.	
5. Replace microphone element with suitable unit if beyond repair.	

METHOD OF EVALUATION:

1. Visual inspection
2. Continuity check
3. Microphone performance

OPERATION SHEET
SC-2-7

COMPETENCY: Test a Phono Pickup

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To test a phono cartridge for normal output.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. If the phonograph is dead, first determine if the amplifier is working. Touch the "hot" terminal at the input plug or at the cartridge output terminals. With volume control turned up, a loud hum should be heard from speaker. If hum is not heard, troubleshoot amplifier or connecting leads. If hum is heard, substitute cartridge.	. SC-1-6 . SC-1-11 . SC-1-7 . IL-1-14 . IL-3-1
2. Test stylus tip by observing it through low-power microscope (Stylus microscope)--it should have a rounded tip, no chisel end.	. IL-3-7 . IL-3-9
3. Check for normal stylus pressure with a stylus pressure gauge. Tone arm adjustment is to be set to value recommended by manufacturer. See Sams information.	
4. Check for normal and equal output from each stereochannel by using a test record and measuring output with meter or oscilloscope.	
5. Visually inspect lug connections at rear of cartridge.	

METHOD OF EVALUATION:

1. Visual inspection
2. Troubleshooting procedure
3. Performance check

OPERATION SHEET
SC-2-8

COMPETENCY: Check a Tape Head

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To identify and correct tape head defects.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. If the tape player is "dead," first determine if the amplifier is working. Touch the "hot" terminal(s) at the input plug of the amplifier or the output lugs on the tape head. If the amplifier is operating, there will be a loud hum from the speaker with the volume control turned up. If hum is present then the tape head or connections to it are defective. DEMAGNETIZE HEAD.	. IL-2-7 . IL-2-8 . IL-2-15 . IL-3-1 . IL-3-12 . SC-2-9
2. Check for continuity through the cable(s) connecting the tape head to the amplifier.	. SC-1-6
3. Check to insure that there are no shorts between the "hot" center conductor of these shielded cables and the outer conductor.	. SC-1-7 . SC-2-10
4. Check for continuity through the internal winding of the tape head.	
5. If head is not repairable, replace with equivalent unit.	
6. Align the replacement head with a test tape. Instructions are given on test tape. This adjustment will insure equal output from both channels with no cross-talk.	

METHOD OF EVALUATION:

1. Visual inspection
2. Troubleshooting procedure
3. Performance check

OPERATION SHEET
SC-2-9

COMPETENCY: Clean and Demagnetize a Tape Head

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To properly clean and demagnetize stereo tape heads.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Method #1 -- Clean tape head carefully with a cotton swab moistened with alcohol. Do not allow any material but the cotton swab to come into contact with tape head. 2. Method #2 -- Clean tape head by spraying it with good grade of commercial tape head cleaner and cotton swab. 3. DEMAGNETIZING TAPE HEAD: Bring demagnetizer near tape head, but NOT TOUCHING HEAD. A good method of protecting head against accidental damage is to place a piece of plastic tape over the head face--and remove it after demagnetizing. With demagnetizer near head, energize it, then move it away from head before de-energizing the tool. (If the demagnetizer is turned off in the vicinity of the head, it will magnetize the head very strongly.)	. IL-3-11 . IL-1-19

METHOD OF EVALUATION:

1. Cleaning procedure
2. Demagnetizing procedure

OPERATION SHEET
SC-2-10

COMPETENCY: Replace a Tape Head

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To remove a tape head and replace with a new unit.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Carefully make an accurate drawing of the leads connected to the tape head. If necessary, tag these leads with marked tape.	. SC-1-4 . SC-1-2 . SC-1-11
2. Carefully unsolder all output leads on tape head.	. SC-2-9
3. Remove mounting screws and brackets noting how they will be replaced on the new unit.	
4. Install replacement head, brackets, and screws, taking care not to scratch head. A piece of plastic tape temporarily placed over head face can prevent this.	
5. Check new head for proper alignment with test tape.	
6. Demagnetize and clean head.	

METHOD OF EVALUATION:

1. Procedure
2. Head alignment

OPERATION SHEET
SC-2-11

COMPETENCY: Test Stereo Headphones

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To determine correct operation of stereo headphones.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine if there is a normal input to phones from amplifier. With audio input to amplifier use a signal tracer to determine the presence of equal signals at phones with no distortion. If these signals are normal, then phones are defective. 2. Check continuity of interconnecting phone leads and plugs. 3. Check for shorts between "hot" lead and ground in these leads and plugs. 4. Check for opens in phone housing, if possible. 5. Substitute phones, if possible.	. SC-1-6 . SC-1-11 . IL-3-1 . IL-3-7

METHOD OF EVALUATION:

1. Procedure
2. Performance check

OPERATION SHEET
SC-2-12

COMPETENCY: Check Crystal Detectors

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To determine the operating condition of crystal detectors.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect ohmmeter leads to crystal diode terminals. Then reverse the test leads. A low reading and a high reading will be obtained. 2. Set ohmmeter to range which gives readable scale indications. Observe readings obtained in the two tests. 3. To obtain the front-to-back ratio, divide the smaller reading into the larger. A rule of thumb is that the ratio should be at least 100/1 for a crystal to be considered for use. 4. The most useful evaluation is obtained by comparing the measured front-to-back ratio with that measured on a known good crystal diode of a similar type, with ohhmeter set on same ranges.	. SC-1-6

METHOD OF EVALUATION:

1. Procedure
2. Test results

OPERATION SHEET
SC-2-13

COMPETENCY: Test a Power Diode

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To use a VOM to determine condition of a rectifier diode.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove power from device in which diode is installed. 2. Disconnect diode from circuit. 3. Connect ohmmeter across diode. Put ohmmeter on suitable range to give readable scale indications. ___ ohms. 4. Reverse ohmmeter leads. Reading will now be opposite in magnitude to previous reading. ___ ohms. 5. Compare readings. The front-to-back ratio is obtained by dividing the low reading into the high reading. Ratio should be 1,000,000/1 or greater. Normal lows are 50-100 ohms. Normal highs are 1 Megohm and higher. Defect readings: Infinite ohms both ways--diode open. Zero ohms both ways--diode shorted. Equal resistance reading both ways--diode leaky.	. SC-1-4 . SC-1-6 . SC-1-11 . IL-2-2 . IL-2-13 . IL-2-12

METHOD OF EVALUATION:

1. Procedure
2. Test results

OPERATION SHEET
SC-2-14

COMPETENCY: Replace a Phono Needle or Cartridge

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To remove and replace a phono needle or cartridge.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
REPLACE CARTRIDGE.	
1. Test the phono pickup to determine if it is defective.	. SC-2-7
2. Make a neat, readable drawing of the output lead connections on pickup.	
3. Disconnect output leads by carefully removing each clip.	
4. Remove mounting hardware and pickup from tone arm.	
5. Replace with identical or equivalent unit.	
6. Set tone arm index.	
7. Set stylus pressure with stylus pressure gauge to recommended value.	
REPLACE NEEDLE.	
1. Determine if needle is defective.	
2. Remove needle carefully.	
3. Install replacement in reverse assembly order.	

METHOD OF EVALUATION:

1. Procedure
2. Performance check

OPERATION SHEET
SC-2-15

COMPETENCY: Adjust an Automatic Changer

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To adjust top mounted components of automatic changer for proper operation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Refer to factory service manual or Sams service information for adjustment specifications.	. IL-3-9 . IL-3-10
2. Adjust tone arm indexing.	. SC-3-8
3. Adjust stylus pressure.	. SC-2-19
4. Adjust tone arm height.	
5. Adjust record push off.	
6. Check for proper operation with record stack.	

METHOD OF EVALUATION:

1. Procedure
2. Performance check

OPERATION SHEET
SC-2-16

COMPETENCY: Phase and Connect Speakers

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To connect multiple speakers with correct phasing.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Speakers must be connected in series, parallel or series parallel combinations so that the combined impedance will be equal to the output impedance taps on the amplifier that is used to drive them.	. SC-1-6 . IL-1-10 . IL-1-15
2. Make a neat wiring diagram of the speaker layout, showing speakers, interconnecting leads and amplifier tap to be used.	. IL-1-16 . IL-1-17
3. Phase all speakers so that cones all move out simultaneously or all pull in together. Solder leads to terminals of "D" cell. Connect leads to speaker circuit input. Feel cone of each speaker as cell is connected--all cones must pull in or move out. If any cone is moving opposite to the rest, reverse connections to its voice coil.	. IL-3-3
4. An ohmmeter can be used to determine speaker impedance. While it does not measure impedance, it will measure voice coil resistance which is about 25% less than impedance.	

METHOD OF EVALUATION:

1. Procedure
2. Phase matching

OPERATION SHEET
SC-2-17

COMPETENCY: Clean Controls, Switches, Contactors

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To remove grime and oxide coatings from contacts.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. If contacts are of the button-against-wiper type, remove tarnish with an ink eraser rubbed over buttons. Then spray with a contact cleaner and work contacts against each other to wipe clean and lubricate thoroughly. 2. If contacts are of the switch type, spray contact cleaner into each switch section rotor. Rotate the contacts several times in both directions. 3. Heavier contacts may first be cleaned with a burnishing tool. Follow burnishing with contact cleaner spray and rotate or slide contacts in both directions. 4. Carbon controls, such as volume controls, etc., are cleaned by spraying cleaner into lug openings on control and then wiping back and forth.	CAUTION: Use contact cleaner that is not injurious to plastics or the insulators may be permanently damaged.

METHOD OF EVALUATION:

1. Procedure
2. Performance check

OPERATION SHEET
SC-2-18

COMPETENCY: Use Resistor and Capacitor Substitution Boxes

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To select the correct resistance or capacitance value on a substitution box and insert it at the correct point in a circuit.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove resistor to be substituted from circuit.	. SC-1-11
2. Dial equivalent correct value on resistor substitution box.	
3. Connect leads of substitution box in place of displaced resistor.	
4. Remove capacitor to be substituted from circuit.	
5. Dial equivalent correct value on capacitor substitution box.	
6. Connect leads of substitution box in place of removed capatitor.	

METHOD OF EVALUATION:

1. Procedure
2. Correct value determined

OPERATION SHEET
SC-2-19

COMPETENCY: Use Sam's Service Information

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To select and locate correct technical data in minimum time.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine make and model number of device. If model number is not evident, try to determine chassis number. 2. Look up in Sam's Index by make and then model number--determine the Sam's set and folder number. 3. Locate the following information in a Sam's folder: Field servicing information Complete schematic diagram Tube layout diagrams Alignment procedures Pictorial part readouts Control locations Set-up procedures Parts list--cross-reference to all manufacturers Voltage and resistance readings "Circuitrace" to locate points on PC boards.	. IL-1-13 EXAMPLE: Make - Admiral Chassis - G13 Set - 915 Folder - #1

METHOD OF EVALUATION:

Check procedure in using index.

OPERATION SHEET
SC-2-20

COMPETENCY: Read and Draw Schematic Diagrams

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To read and draw schematic diagrams competently.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the circuitry to be drawn to establish an initial layout.	. IL-1-13
2. Draw components which are indicated as symbols with the lines connecting them representing wires or connecting islands on a printed circuit board.	NOTE: The schematic diagram is an electronic blueprint.
3. Draw signal progression which is normally from left to right.	
4. Draw voltage readings at schematic diagram points which are taken in respect to ground, unless otherwise noted.	
5. Draw resistance readings which are given in respect to ground.	NOTE: The schematic diagram gives no indication of physical locations of components. It indicates exact electrical connections, however.
6. Show points of connection with a dot, but if two lines in a schematic diagram cross one another and no dot appears at the point of crossing, they are not connected at this point.	
7. Draw connections with a heavy dot where three or more parts are joined physically at a common point.	

METHOD OF EVALUATION:

1. Component layout
2. Signal routing
3. Symbols used

OPERATION SHEET
SC-2-21

COMPETENCY: Use Audio Frequency Generator

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To connect and adjust an Audio Frequency generator for desired frequency.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insert the plug in the line cord AC supply. Snap on power switch. Allow a few minutes warm up for the instrument to stablize.	. IL-3-20
2. Set the waveform selection switch to "SINE" or "SQUARE" as desired.	
3. Set the BAND selector switch to the desired frequency band. Each position on the band selector switch corresponds to a direct reading scale on the dial.	
4. Turn the frequency dial knob until the hairline on the indicator lines up with the desired frequency on the scale corresponding to the band selected.	
5. Output is obtained from OUTPUT jacks and the amount by the output control marked AMPLITUDE. Clockwise rotation increases output.	
6. Connect "HOT" output lead to signal in injection point in circuit under test. Connect common lead from generator to common circuit of device.	

METHOD OF EVALUATION:

1. Procedure
2. Performance check

OPERATION SHEET
SC-2-22

COMPETENCY: Apply Standard Repair Procedures

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To apply to a repair job all standard repair procedures.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Vacuum chassis and inside of cabinet.	. IL-3-11
2. Clean picture tube and window with glass or plastic cleaner.	. SC-4-7
3. Clean tuning dial and knobs.	. SC-4-3
4. Clean and polish cabinet.	. SC-4-14
5. Test all tubes and lamps--replace if defective. Enter replacements on repair order.	. SC-4-47 . SC-4-48 . SC-4-42 through SC-4-45
6. Clean and lubricate all tuner contacts, controls and switches with contact cleaner. (Use ink cleaner on button contacts.)	. SC-5-2 . SC-5-3
7. On BW television receivers, set up picture.	. SC-6-1
8. On color television receivers, set up picture, purity, convergence, and BW tracking.	
9. Check horizontal hold stability and adjust, if necessary.	
10. Complete filling out repair order for the job.	
11. Air test unit for 15 minutes to one hour.	

METHOD OF EVALUATION:

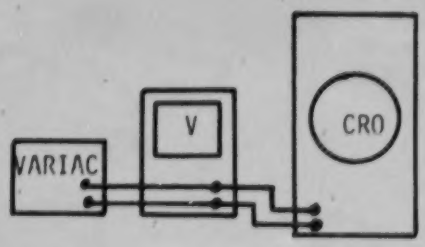
1. Procedure
2. Performance check
3. Visual inspection

OPERATION SHEET
SC-2-23

COMPETENCY: Calibrate a Scope

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To calibrate an oscilloscope for peak-to-peak readings.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect equipment as shown at right. 2. Set the Variac for an output of 2 volts peak-to-peak. This is indicated when the voltmeter reads .707 volts. 3. Adjust scope vertical gain controls for a 2" vertical deflection on screen. Record vertical settings. 4. Raise output of Variac to 20 volts peak-to-peak (p-p). This will be indicated on meter by a reading of 7.07 volts. 5. Readjust vertical gain controls for a 2" vertical deflection on screen. Record vertical settings. 6. Raise output of Variac to 200 volts p-p. This will be indicated by a reading of 70.7 volts on meter. 7. Readjust vertical gain controls for a 2" vertical deflection on screen. Record these vertical settings. 8. Make up table as shown at right and attach to scope. It will be possible to measure p-p values up to 500 volts with this calibration.	 NOTE: This procedure can be used on scopes even if they have no internal calibrating voltage provision. . SC-1-7 . IL-1-21

V. Gain	1v/1"	10v/1"	100v/1"
	15	16	17
V. Atten.	XI	X10	X100

METHOD OF EVALUATION:

1. Procedure
2. Accuracy of calibration

OPERATION SHEET
SC-2-24

COMPETENCY: Use Scope Probe

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To use required oscilloscope probes for television servicing.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. A low capacity (LC) probe is used in all circuits where the inherently large capacity of the direct probe would upset circuit operation and give an improper indication on screen. 2. Use the LC probe in the horizontal section of BW & color television receivers. Use it in all chroma sections of the color receiver. 3. Connect probe tip to signal point in receiver. Remember to multiply by 10 the peak-to-peak value of the observed waveform, as the LC probe attenuates it by this factor. 4. Connect the demodulator probe to view waveforms at any point ahead of the second detector in BW and color receivers. Use demodulator probe for observing chroma waveforms ahead of chroma demodulators. 5. Use the DIRECT probe for all other waveforms in BW and color television receivers.	

METHOD OF EVALUATION:

1. Procedure
2. Scope patterns

OPERATION SHEET
SC-2-25

COMPETENCY: Use an Oscilloscope

COURSE: Radio and Television Repair UNIT II: Solid State and Tube Circuitry and Theory

OBJECTIVE: To connect and adjust an oscilloscope to view an AC waveform.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the sweep selector and sweep vernier at mid-range.	
2. Set the vertical and horizontal centering controls at mid-range.	
3. Set sync selector to INT and sync completely off.	
4. Turn scope ON and advance intensity control about 3/4 turn clockwise.	
5. Set horizontal gain about 3/4 turn.	
6. Let scope warm ip a few minutes and then adjust vertical and horizontal centering controls and not effect on trace. Center the trace properly.	
7. Adjust the focus and intensity for sharpest trace and satisfactory brightness.	
8. Vary horizontal gain and note effect on width of trace.	
9. Connect the vertical input cable center conductor to the circuit point in receiver to view waveform.	
10. Adjust the vertical gain controls to fill 80% of scope screen.	

METHOD OF EVALUATION:

1. Procedure
2. Scope patterns

OPERATION SHEET
SC-3-1

COMPETENCY: Check a Push-Pull Amplifier

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To test a push-pull amplifier for correct procedures.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check tubes and transistors.	. SC-1-6
2. Inject an AF signal into input of amplifier through driver transformer.	. SC-1-7
3. Scope the two base or control grid connections for equal and out-of-phase signals.	. SC-1-12 . SC-1-14
4. Scope the two collector or plate connections for equal, amplified, and out-of-phase signals.	. SC-2-25 . IL-1-14
5. Check operating voltages on stage if waveform is abnormal.	
6. Check stage resistance readings.	
7. Check driver transformer.	
8. Check output transformer.	
9. Check earphone jack.	
10. Check speaker by substitution.	

METHOD OF EVALUATION:

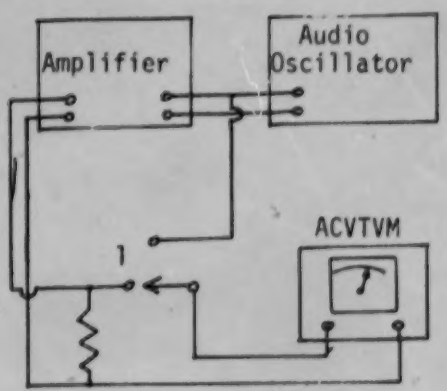
1. Test equipment set-up
2. Sequence of testing
3. Performance results

OPERATION SHEET
SC-3-2

COMPETENCY: Check for High Fidelity Audio Distortion

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To measure amplifier frequency response.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect equipment as shown at right. 2. Set audio oscillator controls for 50 hz. output at maximum rated power level across resistor R. Record in tabular form. 3. Measure voltages at points 1 and 2. 4. Advance audio oscillator to 200 hz. Check voltage at point 2, and reset AF oscillator attenuator, if necessary, for same input voltage as before. Then measure output voltage at point 1 again. Record readings. 5. Repeat this procedure at progressively higher frequencies, to obtain complete frequency response of amplifier. Record all readings. 6. Plot the voltage versus frequency measurements.	 . IL-1-21 NOTE: Power in load resistor R can be found from: $W = \frac{E^2}{R}$ W - power in watts E - rms voltage across R R - load resistor in ohms

METHOD OF EVALUATION:

1. Equipment set-up
2. Accuracy of measurements
3. Accuracy of response curve

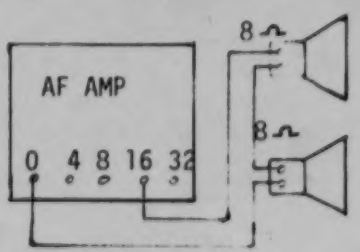
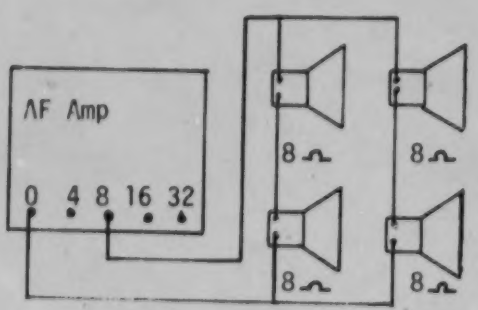
OPERATION SHEET
SC-3-3

COMPETENCY: Match Speaker Impedance

COURSE: Radio and Television Repair

UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To connect speakers to obtain impedance that matches output impedance for maximum power transfer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. To determine the speaker impedance, measure voice coil resistance with ohmmeter on the R 1 range. While this reading is not the actual value, it is very close. i.e. 3.4 ohms for a 4 ohm speaker 7 ohms for an 8 ohm speaker Generally, resistance reading must be increased 15-20% to equal the impedance. 2. To match a single speaker to an amplifier measure its voice coil impedance as listed above. Connect the speaker then to the amplifier output transformer terminals which most closely match this value. AF amplifier output impedances usually are 4 ohms, 8 ohms, 16 ohms, 32 ohms. 3. To match multiple-connected speakers, treat them as series or parallel connected resistors and connect their combined impedance to a match at amplifier output terminals. See diagram at right.	. IL-5-23 . IL-5-33 . IL-5-39  

METHOD OF EVALUATION:

1. Determination of required impedance
2. Speakers connected for required impedance
3. System performance

OPERATION SHEET
SC-3-4

COMPETENCY: Troubleshoot with the Radio Analyst in the Audio Section

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To develop troubleshooting sequence using a radio analyst.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn analyst on--turn on AF output.	. IL-2-15
2. Connect test lead into AUDIO OUTPUT jack on Radio Analyst.	. IL-2-8
3. Connect test lead to input of AF output stage--tone from speaker indicates stage operation.	. IL-1-13 . IL-3-20 . SC-2-1 through SC-2-4
4. If tone is heard, move test lead to input of driver stage--tone from speaker indicates stage operation--should be much louder than in step 3. No sound indicates defective stage.	. SC-2-19 through SC-2-21 . SC-3-1
5. If AF stage precedes driver, move test lead to its input--tone from speaker should be louder than in step 4 if stage is operating OK. Speaker tone here indicates all audio stages are operational.	
6. Inject AF signal to volume control center lug (control on full).	
7. Take voltage measurements in defective stage.	
8. Take resistance measurements in defective stage.	
9. Replace defective component.	

METHOD OF EVALUATION:

1. Equipment set up
2. Correct sequence
3. Isolation of defect

OPERATION SHEET
SC-3-5

COMPETENCY: Troubleshoot with Radio Analyst in the RF Section

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To locate and correct RF defects using the radio analyst.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. To check IF amplifiers, set output of analyst to 455 KHz , modulation on. 2. With receiver on, connect output lead into RF output jack of analyst. 3. Connect test lead to input of final IF amp. With volume on full, a 2000 hz. tone from speaker indicates normal operation of final IF amp. (Plus detector, all AF amps, and power supply) 4. Connect test lead to inputs of remaining IF amplifier stages, in turn, moving from final IF back to converter. A speaker tone indicates all stages after injection point are operating. 5. Failure of tone from speaker indicates defective stage. 6. Measure operating voltages of this stage against normal values on schematic diagram. 7. Check tubes and transistors. 8. Measure stage resistance against schematic for normal values until defect is located.	. SC-2-1 through SC-2-4 . SC-2-19 through SC-2-21 . IL-2-7 through IL-2-11 . IL-216 . IL-3-4 . IL-3-5

METHOD OF EVALUATION:

1. Equipment set-up
2. Troubleshooting sequence
3. Corrective action

OPERATION SHEET
SC-3-6

COMPETENCY: Align the RF and Oscillator Section of an AM SBC Receiver

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To align sections of a receiver to specifications.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Stabilize signal generator and SBC AM receiver by operating for 10 minutes.	. IL-1-13 . IL-1-14
2. Adjust output of signal generator to 1400 KHz, 30% mod.	. IL-2-9
3. Adjust receiver tuning dial to 1400 KHz.	. IL-2-10
4. Inject output of signal generator via injection loop into receiver RF or converter stage.	. IL-2-16 . IL-2-17
5. Connect DC voltmeter to AVC buss.	. IL-2-19
6. Adjust output of signal generator to maintain a 1 tr 2 volt reading as alignment progresses.	. IL-2-20 . IL-2-27
7. Using a non-metallic alignment tool, adjust first the oscillator, then the converter and RF amplifier, input trimmer capacitors for maximum reading on output meter. Recheck these adjustments.	
8. Remove signal generator.	
9. Tune in a weak signal at high end of banc.	
10. Touch-up oscillator and RF trimmers for maximum reading on AVC buss.	

METHOD OF EVALUATION:

1. Equipment set-up
2. Alignment sequence
3. Receiver performance

OPERATION SHEET
SC-3-7

COMPETENCY: Align the IF Section of an AM Radio

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To align a receiver IF section to specifications.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Stabilize signal generator and AM receiver by operating both for 10 minutes.	. IL-1-13
2. Disable receiver local oscillator. (Short oscillator tuning capacitor.)	. IL-1-14
3. Adjust output of signal generator for 455 KHz, modulated 30%.	. SC-1-7
4. Connect signal generator output (RF) to input of first IF amplifier stage.	. SC-2-19
5. Connect DC voltmeter to AVC buss.	. SC-2-20
6. Adjust output of signal generator to maintain a 1 to 2 volt reading as alignment progresses.	. SC-2-27
7. Align the output IF transformer secondary slug, then primary slug for maximum reading on AVC meter.	
8. Similarly, align remaining IF transformers, proceeding from output IF amplifier back to input IF transformer.	
9. Touch-up all IF transformers, beginning a second time at the output IF and ending with input IF.	
10. Restore local oscillator to normal operation.	

METHOD OF EVALUATION:

1. Equipment set-up
2. Alignment sequence
3. Receiver performance

OPERATION SHEET
SC-3-8

COMPETENCY: Use Schematic Diagrams

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To develop competency in locating specific data on schematic diagrams.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Look up Sam's Photofact Folder number in Sam's Index. Listing is by make and model or chassis number. 2. Locate the following in the folder: Schematic diagram Voltage and resistance readings Alignment procedures Parts lists with cross references Component location diagrams Comprehensive adjustment procedures Disassembly procedures. 3. Trace signals on the schematic diagram, signal enters at left and proceeds to right. 4. Locate waveforms and normal voltages which are printed on schematic diagram. 5. Check footnotes which indicate conditions under which these readings are taken.	. SC-2-20

METHOD OF EVALUATION:

1. Use of the index
2. Inventory of contents
3. Location of data
4. Interpretation of data

OPERATION SHEET
SC-3-9

COMPETENCY: Clean and Lubricate Record Changer Mechanisms

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OPERATION: To inspect, clean and lubricate record changer drive components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove retainer and turntable.	. IL-3-9 through IL-3-11
2. Remove drive gear and velocity trip mechanism.	. SC-2-15
3. Clean surfaces with alcohol and soft cloth.	
4. Lubricate gear mating surfaces with thin film of lubricating grease.	
5. Apply lubriplate to hub bearings.	
6. Replace these components in reverse order.	
7. Carefully disassemble lower push rods and levers--a small section at a time--clean with alcohol, reassemble in reverse order, with exception of trip slider or velocity trip.	
8. Clean all rubber drive surfaces with alcohol. They must be oil and grease free.	
9. Use light grade machine oil on idler wheel bearings and spindle.	
10. Recheck changer adjustments.	

METHOD OF EVALUATION:

1. Disassembly sequence
2. Cleaning and lubricating processes
3. Reassembly and operating performance

OPERATION SHEET
SC-3-10

COMPETENCY: Replace Rubber Drives on Changer

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To identify and service faulty drive components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clean spindles shafts and area with alcohol to prevent new rubber surfaces from being contaminated with dirt, oil, or grease. 2. Replace components with new, identical units. 3. Replace with new units all drive belts that are old or stretched. 4. Lubricate pulley and idler wheel shafts with a quality, light grade machine oil. 5. Check for normal operation.	. IL-3-10 . IL-3-11 . SC-3-9 NOTE: Rubber-tired idler wheels or drive wheels will not function properly when rubber becomes oil-soaked, glazed or cracked due to drying out.

METHOD OF EVALUATION:

1. Inspection and cleaning processes
2. Equipment performance

OPERATION SHEET
SC-3-11

COMPETENCY: Repair and Lubricate Tape Mechanisms

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To analyze and repair tape mechanism defects.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clean all tape contact surfaces with a soft, lint-free material and head cleaner or methyl alcohol.	. IL-5-40 . IL-5-41
2. Use alcohol to remove oil and grease from all driving surfaces.	
3. Lubricate bearings and bushings lightly with #20 machine oil. Use a light film of non-hardening grease on cam surfaces.	
4. Demagnetize head when unit is serviced.	NOTE: Avoid using magnetic materials near head.
5. Follow trouble chart on reverse side for symptom/cause of malfunctions.	

METHOD OF EVALUATION:

1. Inspection
2. Troubleshooting sequence
3. Corrective action
4. Equipment performance

SYMPTOM	REMARKS
Capstan does not rotate	Belt dirty, worn or broken Drive assembly binding Motor defective or not supplied with power.
Track-shift Mechanism Inoperative	Switch dirty Shift-cam binding Solenoid defective or not supplied with power Cartridge defective Solenoid linkages bent, worn or missing
Wow or Flutter	Belt worn or dirty Capstan dirty or binding Cartridge defective Motor defective Speed Regulator circuit defective
Sound weak or Distorted	Head dirty, misaligned, defective Cartridge defective Amplifiers defective
Tape is Pulled from Cartridge	Cartridge defective
Cartridge ejector malfunctioning	Ejector mechanism binding Solenoid defective Ejection circuit defective Switch defective

OPERATION SHEET
SC-3-12

COMPETENCY: Troubleshoot Tape Recorder Bias and Erase Oscillators

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To analyze and correct faulty tape recorder electronic components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine presence of oscillator output with an oscilloscope.	. SC-2-1 through SC-2-4
2. Measure tube or transistor voltages against nominal values on the schematic diagram.	. SC-2-12 . SC-2-19
3. Check transistors, tubes, diodes.	. SC-2-20 . SC-1-12
4. Measure stage resistance values against schematic values.	. SC-1-14
5. Check capacitors and coils.	. IL-1-14
6. Make point-to-point continuity readings.	. IL-2-19
7. Replace defective components.	. IL-2-20
8. Check oscillator output on scope for normal frequency and peak-to-peak values.	

METHOD OF EVALUATION:

1. Equipment set-up
2. Troubleshooting sequence
3. Corrective action
4. Equipment performance

OPERATION SHEET
SC-3-13

COMPETENCY: Place and Balance Public Address Speaker Systems

COURSE: Radio and Television Repair UNIT III: AM, FM, and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To layout and install a balanced public address system.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Phase speakers in same listening area.	. SC-3-3
2. Install high impedance lines with matching transformers for runs over 100 feet.	. SC-2-5 . SC-2-16
3. Match impedance of speakers to amplifier output terminals for short transmission line runs.	. IL-3-3
4. Mount speakers high and angle toward audience for optimum coverage.	. IL-3-13 through IL-3-15
5. Speakers should be properly baffled.	
6. Measure speaker balances with metered pick-up microphone.	
7. Adjust individual speaker outputs for optimum sound levels for all areas serviced.	

METHOD OF EVALUATION:

1. Equipment layout
2. Equipment balance
3. Optimum performance

OPERATION SHEET
SC-3-14

COMPETENCY: Repair FM Limiter and Discriminator Stages

COURSE: Radio and Television Repair UNIT III: AM, FM, and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To locate and correct faulty FM components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject 10.7 Mc (Modulated) into input of limiter stage. Wobble generator frequency dial to create FM.	. SC-2-1 through SC-2-4 . SC-1-12
2. Turn volume up; a tone should be heard.	. SC-1-14
3. Test tubes or plug-in transistors.	. IL-3-5
4. Measure tube or transistor voltages.	
5. Measure limiter and discriminator resistances.	
6. Check discriminator diodes with ohmmeter.	
7. After replacing defective component, realign.	. SC-3-15

METHOD OF EVALUATION:

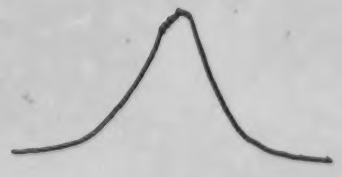
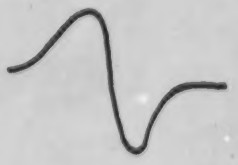
1. Equipment set-up
2. Troubleshooting sequence
3. Corrective action
4. Equipment performance

OPERATION SHEET
SC-3-16

COMPETENCY: Operate the FM Stereo Generator

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To adjust the FM stereo generator to produce an alignment input signal.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
Checking the "Tuner" portion of the receiver	SC-2-25
1. Remove the antenna from the receiver. Connect the terminated cable from the RF output connect of the generator to the antenna terminals.	SC-2-24 SC-3-8 IL-1-13
2. Adjust the generator controls as follows: Function--"RF SWEEP & IF MARKER" Sweep Width--"600 KHz." RF Attenuator-- -40 db Center RF Freq.--zero 19 KHz Sub Level--zero Frequency--Any position	IL-3-17
3. Tune the receiver to 100 Mhz. to pick up the generator signal. Loosely couple the direct cable from the IF marker connector to the first IF of the receiver to produce a 10.7 Mhz. marker.	
4. Connect the vertical input probe of the oscilloscope to the grid resistor on the limiter. Set the scope H selector switch to LINE--phase for a single trace. Normal operation is indicated by trace at right.	
5. Connect the probe of the oscilloscope to the output of the detector. Connect the direct cable from the COMP SIG/Audio connector on the generator to the horizontal input on the oscilloscope. Set the scope H selector switch to H input. Set the generator sweep width to 75- KHz. A properly aligned detector will result in the symmetrical trace at right.	

METHOD OF EVALUATION:

1. Equipment adjustment
2. Correct signal obtained

OPERATION SHEET
SC-3-15

COMPETENCY: Align FM Receivers

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To align an FM receiver to manufacturers specifications.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Selector switch on FM. 2. Follow sequence outlines on the back of this sheet. 3. Check receiver performance to align individual stages.	. IL-1-14 . IL-3-16 . SC-1-7 NOTE: Whenever possible, follow carefully the factory recommended procedure for alignment. Whenever this is unavailable, follow the general procedure outlined on the back.

METHOD OF EVALUATION:

1. Equipment set-up
2. Alignment sequence
3. Receiver performance

Generator frequency	Radio dial setting	Indicator	Adjust	Remarks
10.7 Mhz unmodulated	Point of non-interference	DC probe of VTVM across ½ of ratio detector	All IF slugs	Adjust for maximum
"	"	"	Adjust IF traps	Adjust for minimum
"	"	DC probe of VTVM across output of ratio detector	Adjust radio detector	Adjust for ZERO reading
108.5 Mhz	High frequency end	DC probe of VTVM across ½ ratio detector load	Adjust FM RF and oscillator trimmers	Adjust for maximum

OPERATION SHEET
SC-3-17

COMPETENCY: Align the FM Stereo Decoder

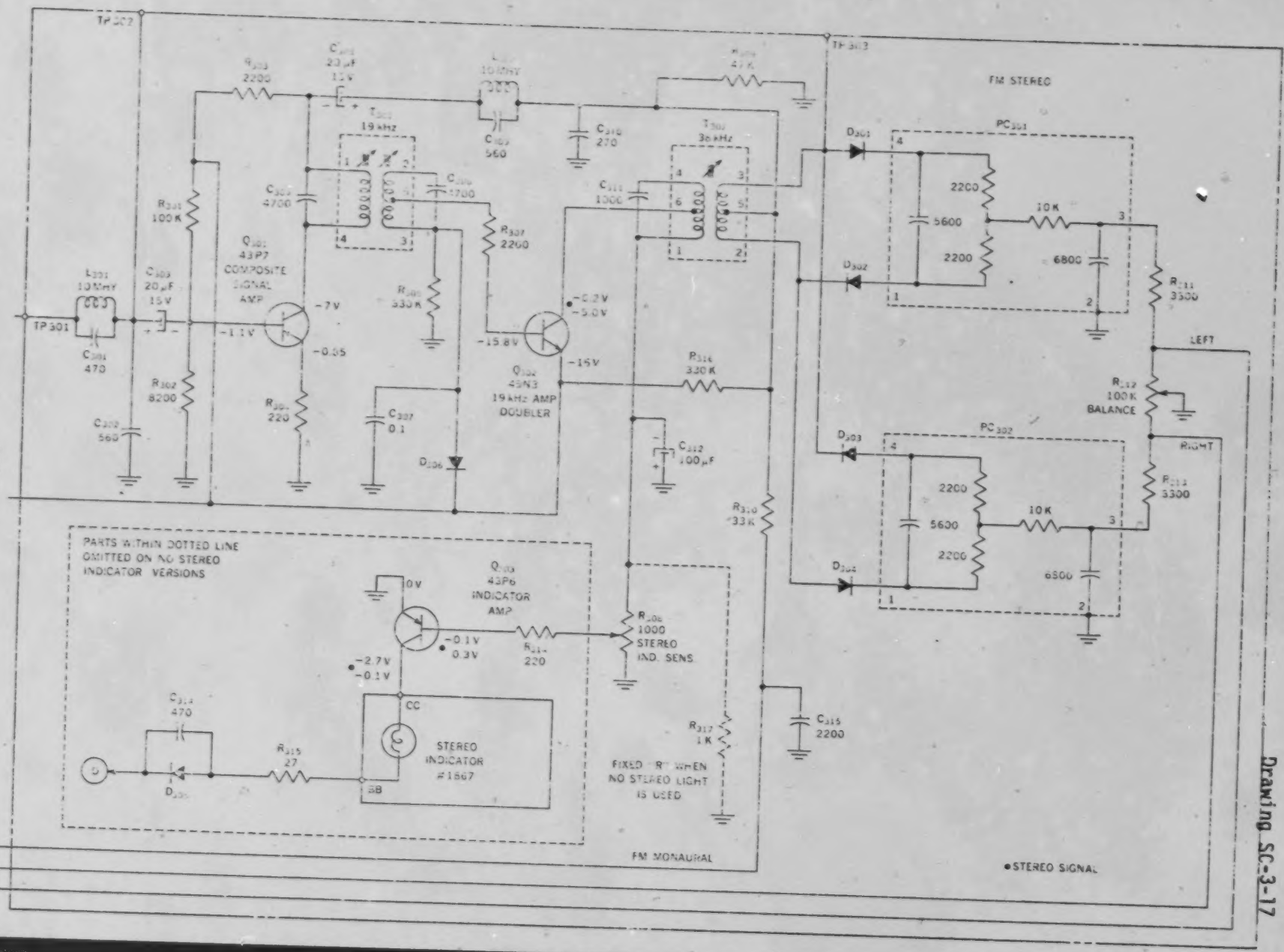
COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in aligning FM stereo decoders.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
For 19 and 38 KHz Transformers 1. Connect a 19 KHz crystal-controlled signal source across R302. Connect an oscilloscope to TP 303. 2. Adjust T301, top and bottom, for maximum output. Two peaks may be obtained; the correct one is the one that has the slugs farthest apart. 3. Adjust T302 for maximum output. For Phasing Adjustment 1. Feed a composite FM stereo signal into the tuner and modulate only one channel, that is, modulate L or R. 2. Connect the oscilloscope to TP 303. 3. Set the oscilloscope on "normal" polarity; that is, positive vertical polarity, and adjust the T301 top slug until the left-channel (L) modulation appears at the top of the envelope or the right-channel modulation appears at the bottom. 4. As a final check, disconnect the speaker(s) from the channel being modulated and adjust the top slug of T301 to eliminate any sound which is being reproduced by the speaker(s) in the other channel.	NOTE: This procedure is recommended for aligning decoder; Refer to the accompanying schematic diagram. . SC-2-19 . SC-2-20 . SC-2-25 . SC-3-16 . IL-3-17 NOTE: The 71 and 67 KHz traps are fixed tuned. When possible, always follow the factory-recommended procedures for the particular decoder alignment.

METHOD OF EVALUATION:

1. Equipment set-up
2. Alignment sequence
3. Receiver performance



Drawing SC-3-17

OPERATION SHEET
SC-3-18

COMPETENCY: Operate a Noise and Distortion Meter

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To determine distortion values in circuitry under test.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect equipment to meet manufacturers specifications.	
2. Set load switch of IM meter to terminate amplifier correctly (If IM meter does not have load facilities, an external load resistor must be provided.)	
3. Set IM test signal to a desired level not exceeding the rated maximum power output of the amplifier.	
4. Adjust IM distortion meter control to the set-level reference position.	
5. Switch the IM distortion meter to % IM on the function dial. Advance range switch as required for ½ or 2/3 full-scale reading.	
6. Compare % of IM distortion on meter scale with nominal value specified by manufacturer.	

METHOD OF EVALUATION:

1. Equipment set-up
2. Testing sequence
3. Accuracy of measurements

OPERATION SHEET
SC-3-19

COMPETENCY: Remove and Replace Auto Radio Antenna

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To identify and correct faulty auto radio antennas.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine if old antenna is defective as follows: A. Connect ohmmeter on RX1 range, between antenna rod and center of transmission line radio plug. Twist transmission line as reading is taken. Resistence should remain at or near zero ohms. B. Connect ohmmeter on RX1 megohm range between antenna and car body (ground). Twist transmission line and vibrate antenna. Reading should remain at zero ohms. C. Connect ohmmeter on RX1 range between ground of antenna plug and car body. Twist transmission line. Reading should remain zero. 2. To remove antenna, loosen antenna mounting nut, remove antenna and transmission line being careful not to scratch car body. 3. Sand inside of fender around antenna mounting hole for good ground connection. 4. Install replacement antenna in fender hole and tighten mounting nut. 5. Connect transmission line plug into receiver.	

METHOD OF EVALUATION:

1. Troubleshooting sequence
2. Isolation of defect
3. Installation techniques
4. Receiver performance

OPERATION SHEET
SC-3-20

COMPETENCY: Suppress Noise in An Auto Radio

COURSE: Radio and Television Repair UNIT III: AM, FM and Audio Systems Analysis and Troubleshooting

OBJECTIVE: To isolate and correct ignition noise in a radio receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Insure good grounds for radio case and antenna by removing paint or coatings where contact is made. (Use sandpaper or emery cloth.)	. IL-3-18 . IL-3-19 . IL-2-5
2. Install interference suppressors between automobile coil hot lead and distributor cap.	
3. Install hood bonds.	
4. Bond-ground cables where they pass thru firewall.	
5. Install generator noise suppression capacitors for generators that have brushes.	
6. Install static suppressors.	
7. Peak antenna trimmer capacitor for maximum volume with receiver tuned to a weak station near 1400 KHz. (Antenna extended)	

METHOD OF EVALUATION:

1. Inspection
2. Sequence of corrective action
3. Receiver performance

OPERATION SHEET
SC-4-1

COMPETENCY: Remove and Replace a Television Chassis

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To remove a TV chassis from the cabinet for service and replace the same in a safe and systematic sequence.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Disconnect power cord and remove the back cover from the receiver.	. IL-1-1
2. Discharge the picture tube hi-voltage with a jumper wire, leaving it installed for several minutes.	
3. Loosen tuner mounting screws with a nut-driver (#8 or #10) and remove the knobs from the front of TV.	
4. Place the tuner on the main chassis where provided for (back apron).	
5. Release screws holding chassis to the cabinet. Some units will have to be removed the entire way.	
6. Disconnect the yoke plug, picture tube socket and hi-voltage lead.	
7. Color receivers have more plugs. Disconnect the convergence and degaussing plug also.	
8. Unhook the speaker wires; in combo receivers this may be more than six.	
9. Lift the chassis by the metal side and remove from cabinet (never the circuit boards or parts).	
10. Service the receiver.	
11. Replace the chassis into the cabinet, making sure wires are not under the metal chassis.	
12. Release the tuner from the apron and mount into the proper place in the cabinet and tighten the screws.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
13. Connect the hi-voltage lead to the picture tube connection. 14. Connect the yoke plug and the speaker wires (color TV; convergence plug and degaussing coil plug also). 15. Connect the picture tube socket to the picture tube using an even pressure and extra care not to cause damage. 16. Insert and tighten the screws into the main chassis from the bottom of the cabinet and tighten same. 17. Replace the back cover and apply power. 18. Give receiver air check to be sure the power connection on the back has made proper contact.	

METHOD OF EVALUATION:

1. Sequence of disassembly
2. Safety precautions
3. Reassembly
4. Final inspection

OPERATION SHEET
SC-4-2

COMPETENCY: Remove and Replace a Black and White Picture Tube

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To remove and replace a black and white picture tube in a safe and orderly manner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove power cord and back cover of receiver.	. SC-4-1
2. Remove chassis as per instruction sheet.	
3. Lay television cabinet on its face with a padded material under it.	
4. Put on safety goggles for eye protection.	
5. Select the proper size nut driver to remove the mounting screws from the brackets in the four corners of the tube.	
6. Remove the deflection yoke from the neck of the picture tube.	
7. Very carefully lift the tube from the case by the bottom of the tube at the face.	
8. DO NOT LIFT THE TUBE BY THE NECK!	
9. Lay the tube on a padded surface and remove the mounting strap from the tube.	
10. Open carton of new tube and lay on a padded surface.	
11. Place mounting strap on the new tube and tighten with slight pressure (CAREFUL, YOU ARE ON GLASS!).	
12. Place the tube with the mounting onto the TV cabinet.	
13. Insert the screws and tighten as required; do not strip.	
14. Replace the chassis as per the instruction sheet.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
15. Write the warranty card as required to activate the warranty. 16. Adjust the deflection yoke after replacing it on the neck, for level. 17. Put the cover on the back and apply power.	

METHOD OF EVALUATION:

1. Sequence of disassembly
2. Safety precautions
3. Reassembly
4. Final inspection

OPERATION SHEET
SC-4-3

COMPETENCY: Adjust the Yoke for Level and Center Picture

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To center the picture on a black and white TV receiver and level the picture with the yoke.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the TV rear cover.	. IL-4-1
2. Install the serviceman's cheater cord.	. IL-4-2
3. Apply the power to the receiver.	
4. Allow a slight warm-up time.	
5. Tune in a local station with a clear picture.	
6. Adjust the vertical hole control, to put the vertical blanking bar in the center of the screen.	
7. Loosen and turn yoke to have the blanking bar level across the receiver screen.	CAUTION: YOKE IS ON GLASS.
8. Tighten the yoke. Set vertical.	CAUTION: YOU ARE ON GLASS NECK OF TUBE.
9. Center the picture with the two tabs at the center of the yoke on the neck.	
10. Turn both tabs to move the picture to the left or right and up and down.	
11. If you cannot see correct center of picture from station, use a test pattern.	
12. Remove the cheater cord and replace the back cover.	

METHOD OF EVALUATION:

1. Preparation
2. Sequence of alignment
3. Centered and leveled correctly

OPERATION SHEET
SC-4-4

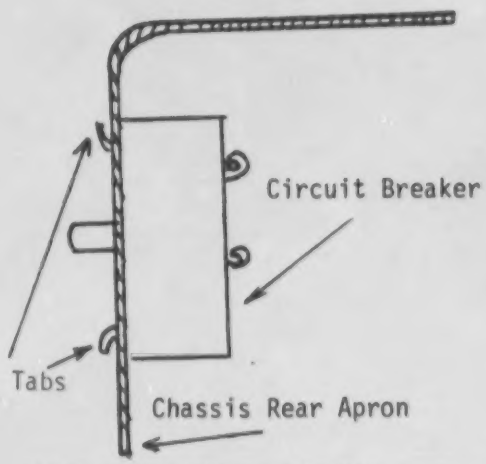
COMPETENCY: Replace Fuse Devices

COURSE: Radio and Television Repair

UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace a circuit breaker in a safe and efficient manner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the rear cover of the TV.	. SC-4-1
2. Remove the chassis from the cabinet.	. IL-4-3
3. Locate the circuit breaker on the rear apron of the chassis.	
4. Desolder (with the correct type iron) the wires connected to the breaker.	
5. Remove the circuit breaker from the chassis apron with a solder aid or long nose pliers.	
6. Select the proper size replacement.	
7. Insert the breaker into the chassis and twist the tabs over to lock into place.	
8. Put wires on the correct terminal.	
9. Solder the wires to the terminals.	
10. Hook-up the test mode and apply power to try out receiver.	
11. Replace chassis into the cabinet.	
12. Replace the rear cover and turn on to check cheater cord connection.	



CUT AWAY VIEW OF CHASSIS

METHOD OF EVALUATION:

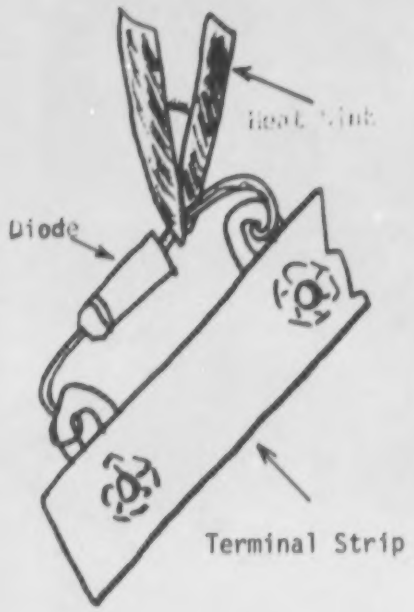
1. Safety precautions
2. Repair techniques
3. Equipment performance

OPERATION SHEET
SC-4-5

COMPETENCY: Replace Low Voltage Rectifiers

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace a power diode safely and correctly.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the chassis from the cabinet. 2. Install heat sink at diode lead to be desoldered. 3. Desolder the diode lead from the terminal strip. 4. Install the heat sink at the other lead of the diode. 5. Desolder this end from the terminal strip. 6. Remove diode from the terminal strip. 7. Replace with a new diode. 8. Install a heat sink on the diode lead to be soldered. 9. Solder this lead to the terminal strip. 10. Install the heat sink to the other lead of the diode. 11. Wrap lead to terminal strip and solder. 12. Remove the heat sink from the diode lead. 13. Replace the chassis into the cabinet. 14. Replace the back cover and give a check on the air for proper reception.	. SC-4-1 

METHOD OF EVALUATION:

1. Safety precautions
2. Repair techniques
3. Equipment performance

OPERATION SHEET
SC-4-6

COMPETENCY: Test for a Short Circuit

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To locate short circuit in the least possible time using electronic test equipment.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Visual inspection to see if there is any discolored or burnt component.	. IL-4-3
2. Connect the ohmmeter scale or range switch to the 100 K range.	. IL-4-4
3. Connect the ground lead of the meter to the chassis or ground point.	
4. Turn off or disconnect all power.	
5. Put the high side of the meter to the side of the component away from the power supply (or fuse device).	
6. Adjust the meter range down all the way down from the 100 K range by each range until you have a reading.	
7. If the reading is zero and you are on the lowest scale, trace the circuit with the meter probe going away from the power supply.	
8. Release the parallel branch circuits as you trace the circuit for the short.	
9. After finding the component that is defective, replace same with a new one and read the resistance of the circuit.	
10. Increase the range of the ohmmeter until you have about a 25 K to 50 K reading to ground.	
11. This is about normal reading for the B+ line to ground in the average radio or television.	

METHOD OF EVALUATION:

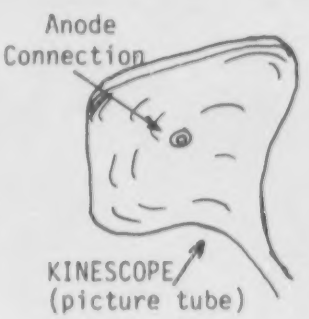
1. Visual inspection
2. Meter settings
3. Test sequence
4. Correction of fault

OPERATION SHEET
SC-4-7

COMPETENCY: Use a High Voltage Probe

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To use the high voltage probe in a safe and effective manner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply power to television receiver.	. IL-4-5
2. Hook-up high voltage probe to the meter to be used.	. IL-4-6
3. If a high voltage probe meter in one unit is to be used, skip step 2.	
4. Set the range of the meter on the highest scale of the meter.	
5. Connect the ground lead of the meter to the chassis only.	
6. Put the high probe side of the meter on the picture tube anode connection. (You may have to lift the rubber seal.)	CAUTION: Keep one hand in your pocket!
7. Move the range of the meter down until you have a middle-of-the-scale reading.	
8. Remove the probe from the anode connection.	
9. Remove the probe from the meter regular probe.	
10. Remove the ground lead from the chassis.	
11. Disconnect the power from the television receiver.	

METHOD OF EVALUATION:

1. Visual inspection
2. Safety precautions
3. Meter settings
4. Test sequence
5. Correction of fault

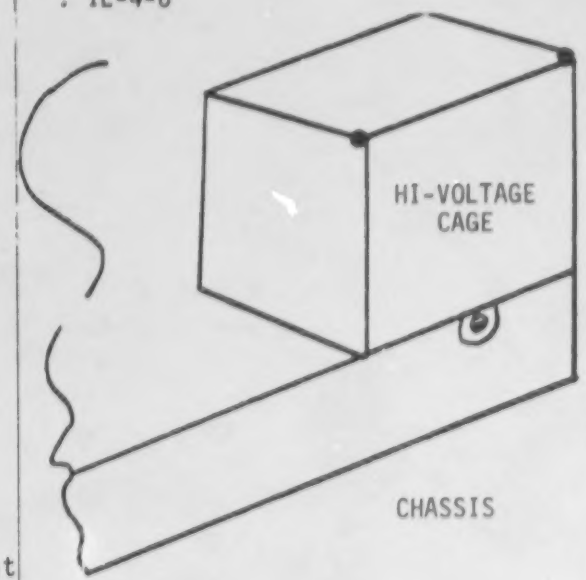
OPERATION SHEET
SC-4-8

COMPETENCY: Replace High Voltage Rectifiers

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace high voltage rectifiers in a safe and efficient manner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Ground the high voltage connection at the picture tube anode with a jumper wire to chassis (only).	. SC-4-7 . IL-4-5 . IL-4-6
2. Allow the jumper wire to remain on a few minutes to discharge the voltage.	
3. Open the high voltage cage.	
4. Remove the short on the anode of the picture tube.	
5. Remove the high voltage tube from the socket by pulling outward and SLIGHT rocking motion.	
6. If the rectifier is a solid state unit, desolder the connections.	
7. Remove the solid state rectifier.	
8. Replace the unit with a new one.	
9. Solder the solid state unit in with care; make connection a ball of solder to prevent arcing.	
10. Replace the high voltage cover or cage.	CAUTION: Make sure the jumper wire from the anode connection to ground is removed.
11. Apply power to television receiver.	
12. Adjust the high voltage as required (color receiver only).	
13. Disconnect the power.	



METHOD OF EVALUATION:

1. Safety precautions
2. Repair techniques
3. Equipment performance

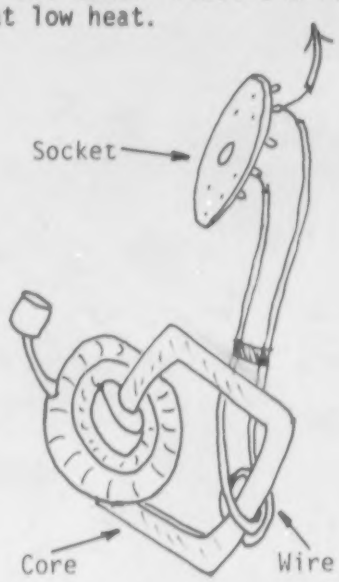
OPERATION SHEET
SC-4-9

COMPETENCY: Replace High Voltage Rectifier Filament Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace filament wire in the high voltage rectifier circuit and transformer.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Discharge the high voltage on the picture tube anode to ground.	. IL-4-5
2. Leave the jumper wire on the anode for several minutes.	
3. Open the high voltage cage.	
4. Remove the sides of the high voltage cage if needed to get to the tube socket and connections.	
5. Remove the tube from the socket.	
6. Remove the tube socket from the high voltage mounting insulator.	
7. Desolder the wires from the tube socket pins.	NOTE: Use care. Plastic will melt at low heat.
8. Remove the wire from the core of the high voltage transformer. (Count the turns.)	
9. Place new HIGH VOLTAGE wire on the core of the transformer and attach to pins on tube socket.	
10. Solder the pins with care and make ball or extra smooth type solder joints.	
11. Replace the tube socket into the socket insulator.	
12. Replace the tube into the socket.	
13. Replace the high voltage cage and close the lid tight.	



COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
14. Make sure the jumper from the second anode is removed from it and ground.	

METHOD OF EVALUATION:

1. Safety precautions
2. Repair techniques
3. Equipment performance

OPERATION SHEET
SC-4-10

COMPETENCY: Replace High Voltage Transformers

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace the high voltage transformer in a power supply.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open the high voltage cage and remove all hindering sides.	. IL-4-5
2. Make a chart or layout sheet of the wires and connections before next step.	
3. Desolder and disconnect the wires to the "doughnut" connections first.	
4. Remove the high voltage socket from the insulator.	
5. Remove the high voltage tube.	
6. Desolder the filament wires from the pins on the socket.	
7. Remove the wires from the pins on the tube socket.	
8. Unscrew the mounting screws from the transformer mounting and remove from chassis.	
9. Install a new transformer; mount in the chassis with the mounting screws.	
10. Connect the filament wires to the pins of the tube socket.	
11. Solder the wires with smooth or ball type solder joints.	
12. Connect the socket to the insulator and install into the cage.	
13. Connect the wires on the rest of the transformer connections; check the layout sheet you drew previously.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
14. Solder the wires to the terminals with ball or smooth type joints.	
15. Insert the high voltage tube into the socket (should use a new one).	
16. Replace the high voltage cage.	
17. Close the lid and screw all parts of cage tight.	
18. Apply power to receiver and check for chrona in the high voltage cage.	
19. Adjust the high voltage as required by service literature.	
20. Disconnect the power.	

METHOD OF EVALUATION:

1. Safety precautions
2. Repair techniques
3. Equipment performance

OPERATION SHEET
SC-4-11

COMPETENCY: Solder in the High Voltage Circuit

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in soldering high voltage circuit components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the high voltage cage lid and any sides that are in the way.	. IL-4-5
2. Desolder the connections at the high voltage tube socket with the least amount of heat and in the quickest time.	
3. The insulator material used in the voltage socket insulator will melt at low temperatures.	CAUTION: Do not splash any solder on anything in this area; Make sure splashed solder is cleaned off all components.
4. There will be a chrona or arcing between the case and joints that have a rough solder on them.	
5. All solder joints must be smooth or balled.	
6. Connect the wires to high voltage socket pins and secure.	
7. Solder the connections as fast as possible.	
8. Use as little as possible solder on the joints.	
9. Keep heat at low temperature and cause the solder to form a ball on the connection pins.	
10. Replace the high voltage lids and the sides that were removed.	
11. Connect the power cord and check for a leak in the cage; look for chrona to the case.	
12. Disconnect the power cord.	

METHOD OF EVALUATION:

1. Safety precautions
2. Repair techniques
3. Clean up
4. Equipment performance

OPERATION SHEET
SC-4-12

COMPETENCY: Check TV Tuner Construction

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in servicing a TV tuner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the rear cover of the receiver.	. IL-4-7
2. Remove the mounting screws for the tuner.	. IL-4-8
3. Some tuners have screws and slots and the screws do not have to be removed all the way.	
4. Remove the tuner to the rear of the cabinet to get at it with comfort.	
5. Visually inspect the fine tuning gear system to be sure of proper function; do not over lubricate.	
6. Visually inspect the contacts for each channel; if dark color, clean.	
7. Visually inspect the shafts and contacts for excessive wear.	
8. Visually check the oscillator adjustment and set in middle of range.	
9. Clean with tuner cleaner and then spray with a contact lubricant cleaner.	
10. Replace the tuner into the cabinet on the mounting screws.	
11. Tighten the screws to the tuner.	
12. Replace the rear cover of the television.	
13. Apply the power to give the receiver a check on the air.	

METHOD OF EVALUATION:

1. Inspection procedures
2. Servicing sequence
3. Tuner performance

OPERATION SHEET
SC-4-13

COMPETENCY: Adjust the Oscillator Section of a TV Tuner

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting the oscillator section of a TV tuner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the front tuner VHF tuner know.	. IL-4-7
2. Remove the fine tuning knob of the VHF tuner.	. IL-4-8
3. Set the tuner to Channel 13 or the highest channel received in the area.	
4. With a long plastic screwdriver, adjust the tuner through the front of the tuner.	
5. Check the front fine tuning range and make sure it is set to the middle.	
6. Readjust the oscillator slug to get the picture and sound on the correct channel number.	
7. Set the tuner to the low frequency band (ch. 6-2) Ch. 6.	
8. Adjust through the front of the set to the tuner slug with the long plastic screwdriver.	
9. Adjust the correct setting of the slug for the correct channel.	
10. Check all channels received in the area to make sure the fine tuning has enough range on each one.	
11. Readjust from the highest channel if all the channels are off on fine tuning (good picture and sound).	
12. Replace the knobs on the front of the television	

METHOD OF EVALUATION:

1. Use of technical data
2. Alignment techniques
3. Equipment performance

OPERATION SHEET
SC-4-14

COMPETENCY: Clean and Lubricate TV Tuners

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in cleaning and lubricating television tuner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove tuner from tuner mounting bracket.	. IL-4-7
2. Remove tuner cover from tuner.	. IL-4-8
3. For the "Drum" type tuner, apply the cleaner to the contacts and wipe off.	. SC-4-12
4. For the switch type tuner, spray a tuner wash to the contacts only.	. SC-4-13
5. After the tuner is dry, spray a coat of cleaner/lubricant.	
6. Be sure not to spray the neutralize capacitor in the RF section.	
7. If the tuner oscillates on the high channels, reclean with the wash spray.	
8. After the second wash, spray the lubricant on the contacts; not the capacitor.	
9. Replace the tuner into the cabinet.	
10. Replace the tuner cover.	
11. Check receiver for normal operation.	
12. Replace the rear cover of the TV.	

METHOD OF EVALUATION:

1. Visual inspection
2. Servicing techniques
3. Equipment performance

OPERATION SHEET
SC-4-15

COMPETENCY: Replace Parts in a TV Tuner

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To replace components in a television tuner.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the tuner from the tuner mounting brackets. 2. Remove the cover from the tuner. 3. If a "drum" type tuner, remove the drum part of the tuner. 4. Release the springs holding the drum in place; caution--may jump out! 5. Desolder the defective components with a small soldering iron or low wattage. 6. Remove the parts with the long nose pliers or tweezers. 7. Install the new part using the long nose pliers. 8. Solder the components in place with the low heat solder iron. 9. Replace the drum and the spring that held the drum into place. 10. Replace the tuner cover. 11. Replace the tuner into the tuner mounting bracket. 12. Apply power to the television for on the air check. 13. If the tuner is not the drum type, a whole switch unit may have to be removed to get to the defective part.	. IL-4-7 . IL-4-8 . IL-4-12 through IL-4-14

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
14. If the switch is faulty, a new one must be installed; USE ONLY FACTORY PARTS. 15. Always check the oscillator section after a tuner repair for correct frequency on channel.	

METHOD OF EVALUATION:

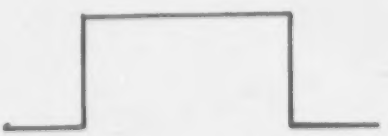
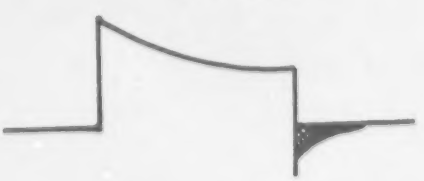
1. Use of technical data
2. Service techniques
3. Repair techniques
4. Equipment performance

OPERATION SHEET
SC-4-16

COMPETENCY: Check the Video Amplifier with the Oscilloscope

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in checking a video amplifier with the oscilloscope.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up the chassis with the bench set-up equipment. 2. Insert a square wave into the video amplifier input (grid for tube). 3. Check the output of the stage with the scope. 4. Compare the transistor receiver with the service literature. 5. Compare the signal displayed which should look as close to drawing A as possible for correct operation. 6. If the wave is like drawing B, it is a loss of high-frequency response which must be corrected. 7. If the wave is close to drawing C, it is insufficient low-frequency response, which must be corrected. 8. If conditions of #6 or #7 exist, check the peaking coils for defects. 9. Desolder the peaking coils, if defective. 10. Replace the part with a new one of the same value. 11. Solder the part into the circuit. 12. Disconnect the equipment. 13. Apply power to the receiver and give a check on the air.	. IL-4-9 . IL-4-10 NOTE: In a tube receiver, this will be the plate circuit.  a. correct video signal b. Insufficient high-frequency  c. Insufficient low-frequency

METHOD OF EVALUATION:

1. Use of technical data
2. Oscilloscope set-up
3. CRT pattern interpretation
4. Repair techniques
5. Equipment performance

OPERATION SHEET
SC-4-17

COMPETENCY: Adjust AGC and Noise Controls

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting AGC and noise controls.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Tune receiver to the strongest local station.	. IL-4-12
2. Find the controls on the rear apron of the television receiver.	. IL-4-13
3. Use a screwdriver for the turning of the controls.	
4. Adjust the AGC control till the picture blacks out and the sound either buzzes or stops.	
5. Bring the AGC control around the opposite direction till the picture reappears.	
6. Turn the AGC control another 1/4 turn in the same direction as above.	
7. Turn the noise control till the picture starts to get the "bends."	
8. Reverse the noise control till the "bends" clear up.	
9. Tune to a weak station and check for proper reception of color and black and white.	
10. Move channel dial off station and back again fast to see if the AGC recovers.	
11. If AGC seems to hang up, lower the setting of the control.	
12. Disconnect power to the receiver.	

METHOD OF EVALUATION:

1. Use of technical data
2. Alignment techniques
3. Receiver performance

OPERATION SHEET
SC-4-18

COMPETENCY: Substitute External Bias in the AGC Circuit

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting external bias in the AGC circuit.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up the receiver to the bench receiver test set-up.	. IL-4-12
2. Locate the AGC test point on the receiver service literature.	. IL-4-13
3. Locate the test point for AGC on the television receiver.	. IL-4-17
4. Connect the high or positive side of the power supply to the chassis.	
5. Connect the negative side of the power supply to the IF AGC point on the receiver.	
6. Adjust the bias supply from zero volts to about eight volts.	
7. Tune in a local station on the defective receiver.	
8. While watching the picture, adjust the IF AGC for the picture without bending.	
9. Connect the bias supply to the first IF stage and adjust for a good picture.	
10. Make note of the amount of voltage needed to have a good picture on the screen.	
11. Insert a bias on the AGC control grid; adjust from zero to full for the same amount of voltage on first IF stage.	
12. Remove the external bias supply from the receiver.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
13. Disconnect the receiver from the test set-up.	

METHOD OF EVALUATION:

1. Use of technical data
2. Alignment techniques
3. Receiver performance

OPERATION SHEET
SC-4-19

COMPETENCY: Check Sync with an Oscilloscope

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in checking sync with the scope.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook-up the receiver to the test set up for the bench.	. IL-4-13
2. Tune in a strong local signal.	
3. Use the direct probe for the scope.	
4. Trace signal right from the video amplifier take-off point to the sync.	
5. Put the probe on the grid of the sync slipper stage and record the peak-to-peak value.	
6. Refer to the diagram for the receiver under testing for the correct polarity.	
7. Spread the display on the scope CRT so you can distinguish the trace.	
8. Set the scope on the vertical frequency and then on the horizontal.	
9. Observe the shape of the wave.	
10. Measure the voltage of the wave and compare to the service specifications.	
11. Put the probe on the output of the sync stage and observe the waves.	
12. Check the voltage and shape of the wave.	
13. Compare the results on the scope with that on the service literature.	
14. Disconnect the test equipment from the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Oscilloscope set-up
3. Accuracy of measurements

OPERATION SHEET
SC-4-20

COMPETENCY: Substitute the Sync Signal with the TV Analyst

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in inserting the TV analyst sync as a substitute for the missing receiver sync.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hook up the receiver to the bench test set-up.	. IL-4-13
2. Apply power to the receiver.	. SC-4-19
3. Acquire service literature for receiver.	
4. Turn on B & K 1077 analyst.	
5. Connect the lead from the ground of the 1077 to the chassis of the receiver.	
6. Connect the sync lead from the 1077 to the input of the sync stage.	
7. Connect the sync lead from the output of the sync stage if set doesn't stand still.	
8. Connect the sync lead from the 1077 to the vertical input.	
9. Connect the sync lead from the 1077 to the horizontal input AFC stage.	
10. If any of the above inserting points cause the picture to stand still, you have found the defective stage.	
11. Disconnect all the test equipment and turn off all of the power.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing procedures
3. Isolation of defective stage

OPERATION SHEET
SC-4-21

COMPETENCY: Adjust Vertical Sweep Controls

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To adjust the vertical height and line controls on the television receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn on receiver to be adjusted.	. IL-4-14
2. Tune in local strong station or use the cross bar generator.	
3. Adjust the vertical height control for the entire size of the picture.	
4. Adjust the vertical line control for a part of the picture, either the top or the lower half of the picture.	
5. Adjust to get the proper size to fill the screen in full top to bottom.	
6. Adjust so that raster lines are evenly spaced on the screen.	
7. If you use a generator for this operation, check a live show to keep the people from having a flat head.	
8. Some of the new sets have a vertical bias control which must be adjusted in addition to the height and linearity.	
9. Some of the transistor type receivers will have only one control, the size, which is adjusted to obtain a correct vertical alignment.	NOTE: The linearity of some of the new sets is adjusted with automatic circuits and there is no control whatsoever!
10. Turn off the power to the receiver.	

METHOD OF EVALUATION:

1. Use of technical data
2. Alignment techniques
3. Video presentation

OPERATION SHEET
SC-4-22

COMPETENCY: Check the Vertical Sweep with the Oscilloscope

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in checking vertical sweep circuits with the oscilloscope.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the receiver for operation with the bench test set-up.	. IL-4-14
2. Turn on the receiver and allow warm-up time.	. IL-4-15
3. Tune to a local clear station.	
4. Adjust the hold circuits for good sync of the picture on the screen.	
5. Use the direct probe on the scope.	
6. Check the sweep at the vertical oscillator output.	
7. Consult service literature for connections of the circuits.	
8. Put the black lead or ground lead from the scope to the chassis.	
9. Put the probe from the scope vertical input to the input of the vertical sweep driver or output stage.	
10. Put the scope to the output of the vertical output stage.	
11. Check the wave with the scope probe at the vertical output transformer.	
12. Compare the above wave forms on the scope with those in the service literature.	
13. Disconnect the service equipment from the receiver under test.	

METHOD OF EVALUATION:

1. Use of service data.
2. Test equipment set-up
3. Service techniques
4. CRT pattern interpretation
5. Receiver performance

OPERATION SHEET
SC-4-23

COMPETENCY: Trigger Vertical Sweep from External Source (Vertical Grid Drive)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in obtaining and use of vertical sweep with the B & K TV analyst 1077 (with a vertical grid drive).

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject the VHF signal to the antenna terminals of the receiver.	. IL-4-14
2. Disable the vertical oscillator by removing the tube or short the grid to ground.	. IL-4-15
3. Connect the black lead to the 1077 to the chassis of the TV.	
4. Connect the red lead from the VERTICAL GRID DRIVE jack to the grid of the oscillator.	
5. Set the amplitude control to the middle of its range.	NOTE: Note on the screen that vertical deflection has been restored but may not be adequate.
6. Adjust the screen for proper or as close to normal (with the 1077 Amplitude control) deflection vertically.	
7. If the receiver has a multi-vibrator for the vertical sweep, disable the feedback path.	
8. Feedback path is usually a capacitor and a resistor from the output plate circuit to the oscillator grid.	
9. If vertical sweep occurs on the screen, you can assume the vertical, output transformer, yoke and output amplifier are all okay.	

METHOD OF EVALUATION:

1. Test equipment set-up
2. Service techniques
3. Interpretation of results

OPERATION SHEET
SC-4-24

COMPETENCY: Trigger Vertical Sweep From External Source (Vertical Plate Drive)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in obtaining and use of vertical sweep circuits with the B & K TV analyst 1077 (with a vertical plate drive).

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject the VHF signal in the antenna terminals of the receiver.	. IL-4-14
2. Remove power from the receiver.	. IL-4-15
3. Remove the vertical output tube.	. IL-4-23
4. Connect the black lead from the 1077 to receiver chassis.	
5. Connect the red lead from the PLATE DRIVE jack to the plate pin of the tube socket for vertical output.	
6. Place the HOR-OFF-VERT switch in the VERT position.	
7. Apply power to the receiver.	
8. Vertical sweep will occur if the yoke and the transformer are okay.	
9. The amplitude control on the 1077 will adjust the size of the sweep on the TV.	
10. Remove power from the receiver.	
11. Remove the red test lead and the ground lead to the chassis.	
12. Replace the vertical output tube.	
13. Disconnect the VHF signal to the antenna.	

METHOD OF EVALUATION:

1. Test equipment set-up
2. Service techniques
3. Interpretation of results

OPERATION SHEET
SC-4-25

COMPETENCY: Trigger Vertical Sweep from External Source (Solid State Vertical Stage)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in obtaining and use of vertical sweep circuits with the B & K TV analyst 1077 (solid state vertical sweep).

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject a VHF signal to the antenna terminals of the receiver.	. IL-4-14
2. Disconnect the power source.	. IL-4-15
3. Connect the black lead from the 1077 to the receiver chassis.	. IL-4-23
4. Set the HOR-OFF-VERT switch to the VERT position.	. IL-4-24
5. Connect the red lead to the SOLID STATE SWEEP DRIVE, and the base of the vertical output transistor.	
6. Set the AMPLITUDE control to the maximum.	
7. Apply power to the receiver.	
8. If sweep occurs, the vertical output transistor is good.	
9. Disconnect the power and connect the red lead to the base of the driver transistor.	
10. Apply power to the receiver.	
11. If sweep occurs, the driver and output transistors are good.	
12. Disconnect the power and connect the red lead to the oscillator transistor.	
13. If sweep occurs, the oscillator transistor is good. Check for other parts defective.	
14. Disconnect power and all test equipment.	

METHOD OF EVALUATION:

1. Test equipment set-up
2. Service techniques
3. Interpretation of results

OPERATION SHEET
SC-4-26

COMPETENCY: Adjust the Horizontal Sweep Controls

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting the horizontal sweep controls.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject a signal into the antenna of the receiver.	. IL-4-16
2. Apply power to the television.	
3. Set the horizontal hold control to middle of its range.	
4. Adjust the frequency coil with a plastic screwdriver to bring the picture into correct horizontal sync on the screen.	
5. Knock the receiver off channel by turning the VHF channel knob to an unused channel.	
6. Readjust the horizontal frequency coil to correct any slow recover of the picture.	
7. If the receiver has only one control (frequency coil), skip step 3.	
8. If receiver has a range control and a hold control, set the hold control for the mid-range and then the range control to mid-range.	
9. Adjust the frequency coil for correct picture after all the other controls have been set.	
10. Adjust the color receiver horizontal efficient coil for correct current flow in the output stage, as required by the service literature.	
11. Disconnect the power to the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Video presentation

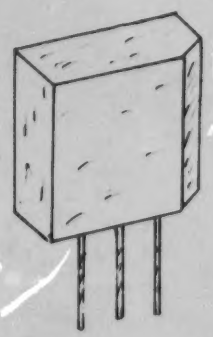
OPERATION SHEET
SC-4-27

COMPETENCY: Repair the Horizontal AFC Circuit

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in repairing the horizontal AFC circuit.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Desolder the dual-diode from the circuit board with a low heat iron.	NOTE: In the tube receiver, the horizontal diode is a dual-diode unit.
2. Use a heat sink when installing the new diode unit.	. IL-4-16
3. Very old TV receivers may have a horizontal oscillator with a tube that contains the AFC also.	. IL-4-24
4. In the transistor type receiver, the AFC diodes will be single units.	
5. Desolder this type unit as above.	
6. Install the new type diodes. (Be sure to replace both of the diodes at the same time.)	
7. Use the low heat solder iron and a heat sink.	
8. When replacing the AFC diodes, replace the horizontal oscillator tube also.	
9. Apply power to the receiver and check for correct frequency of the oscillator.	
10. Adjust the horizontal AFC.	. SC-4-26
11. Disconnect the power to the receiver.	



DUAL - DIODE

METHOD OF EVALUATION:

1. Repair techniques
2. Receiver performance

OPERATION SHEET
SC-4-28

COMPETENCY: Repair Horizontal Oscillator Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in repairing horizontal oscillator circuits.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Test the tube or transistor in the horizontal socket.	. IL-4-16
2. Solder all the grounds at the oscillator position to the chassis and circuit board.	. IL-4-24 . IL-4-25
3. Make a voltage reading on the oscillator control grid (tube will be negative).	
4. Make a voltage reading at the plate of the oscillator tube connection.	
5. Make a voltage reading at the grid of the second section of the oscillator tube (a scope can be used at this point).	
6. If the control grid voltage is lower than normal, check the feedback capacitors.	
7. Check for output of the oscillator at the control grid of the horizontal output tube with a: a. Scope for p-p wave form (about 150 volts) b. Volt meter for negative voltage (50 volt)	
8. If the oscillator is oscillating but off frequency, substitute the parts in the hold circuit in the control grid of the oscillator tube.	
9. If the AFC circuit is suspected as the defective stage or part of the oscillator, ground the oscillator grid and the oscillator should "free wheel."	NOTE: Black color blanking bar vertical with picture on each side of the bar, unstable)

METHOD OF EVALUATION:

1. Troubleshooting procedures
2. Use of test equipment
3. Location of defective component

OPERATION SHEET
SC-4-29

COMPETENCY: Substitute Horizontal Sweep Drive

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the TV analyst B & K 1077 (grid drive signal) for the horizontal sweep drive signal.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject a VHF signal to the antenna terminals of the receiver.	. IL-4-16
2. Disconnect the power source to the TV.	. IL-4-17
3. Disable the horizontal oscillator; pull tube.	
4. Remove the plate cap from the high voltage rectifier tube.	
5. Connect the high voltage indicator test lamp to the insulation of wire on #4.	
6. Connect the black test lead from the 1077 ground to the receiver chassis.	
7. Connect the red lead from the HORIZONTAL GRID DRIVE jack to the horizontal amplifier grid.	
8. Reapply power to the receiver.	
9. If lamp glows, it indicates the horizontal output stage and all else in that circuit is okay.	
10. If lamp does not glow, it means that the horizontal output section is defective.	
11. Disconnect the power.	NOTE: If the lamp does glow, it must mean a defective horizontal oscillator.

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-30

COMPETENCY: Substitute Horizontal Sweep Drive (Plate)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the TV analyst B & K 1077 (horizontal plate drive) for the horizontal plate drive.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inject a VHF signal into the receiver terminal for the antenna.	. IL-4-16
2. Disconnect power from receiver.	. IL-4-17
3. Remove the plate cap from the horizontal output tube.	. SC-4-29
4. Connect the black lead from the 1077 ground to the receiver chassis.	
5. Connect the red lead from the 1077 PLATE DRIVE jack to the lead that was removed in #3 above.	
6. Place the HORZ-OFF-VERT switch in the HORZ position.	
7. Apply the power to the receiver.	
8. If the BOOSE indicator lamp glows, this means that B+ boost voltage is being developed in the high voltage.	
9. Most times this means that the output transformer and deflection yoke are okay.	
10. Disconnect the power.	CAUTION: High voltage may be present at the area.
11. Disconnect all test equipment leads.	

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-31

COMPETENCY: Substitute Tuner and Video IF with the TV Analyst

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the B & K TV analyst 1077 for the tuner and IF.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the receiver back.	. IL-4-17
2. Install isolation transformer if needed.	. IL-4-18
3. Remove the IF input plug from socket.	
4. Connect the black lead from the 1077 to the television chassis.	
5. Connect the RF cable from the RF output jack to the IF input on the receiver.	
6. Apply power to the receiver.	
7. Set the RF ATTENUATOR to 10.	
8. Set the RF SELECTOR to IF position.	
9. Adjust the IF control to the IF frequency of the receiver (45.75 MHz).	
10. Set the VIDEO control to mid-range.	
11. Readjust the RF ATTENUATOR to proper picture on the screen of TV.	
12. The picture on the receiver should stand still and display a test pattern.	
13. If tuner is defective, the signal from the 1077 will come through the IF stages to the screen.	
14. If the IF stage(s) is defective, there will be a plain white screen without picture.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
15. Disconnect the test leads from receiver. 16. Shut off power to the receiver and 1077.	

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-32

COMPETENCY: Substitute Tuner and Video IF with the TV Analyst (IF stages)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the B & K analyst 1077 for the IF stage.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the receiver back.	. IL-4-17
2. Install isolation transformer if needed.	. IL-4-18
3. Remove the IF input plug from socket.	. SC-4-31
4. Connect the black lead from the 1077 to the receiver chassis.	
5. Connect the RF cable from the RF output jack to the 3rd IF stage grid.	
6. Apply power to the receiver.	
7. Set the RF ATTENUATOR to highest point.	
8. Set the RF SELECTOR to IF position.	
9. Adjust the IF control to the IF frequency of the receiver (45.95 MHz).	
10. Set the VIDEO control to mid-range.	
11. If you have a faint picture on the screen, the 3rd IF stage is okay.	
12. Connect the RF cable to the 2nd IF grid.	
13. Reduce the RF output; if you have a picture on the screen, the 2nd IF is okay.	
14. Connect the RF cable to the 1st IF grid; reduce output.	
15. If the picture is on the screen, the IF stages are all okay.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
16. Disconnect the test leads and power to receiver and 1077.	

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-33

COMPETENCY: Substitute the Video Signal with the TV Analyst

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the B & K TV analyst 1077 for the video signal.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the receiver back.	. IL-4-17
2. Install isolation transformer if needed.	. IL-4-18
3. Connect the black lead to the chassis.	. SC-4-31
4. Connect the red lead to the VIDEO jack on the 1077.	. SC-4-32
5. Connect the other end of the red lead to the input of the video output stage.	
6. Apply power to the receiver.	
7. Set the video control to the highest point (10).	
8. If the output stage is okay, a picture will appear on the screen out of sync.	
9. If the picture is a negative polarity, reverse the VIDEO POLARITY switch.	
10. If the picture is on the screen, the stage is okay.	
11. Connect the red lead to the input of the 1st video stage.	
12. If the picture is on the screen, this stage is okay also.	
13. Disconnect the power and the test leads.	

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-34

COMPETENCY: Substitute Sound with the TV Analyst (Audio Stages)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop an understanding in substituting sound signals with the B & K TV Analyst 1077

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the receiver cover.	. IL-4-17
2. Install isolation if needed.	. IL-4-18
3. Connect the black lead from the 1077 to the receiver chassis.	. SC-4-29
	. SC-4-31
4. Connect the red test lead from the 1KHz jack to the high side of the speaker voice coil on receiver.	. SC-4-33
5. A low volume audio tone will be heard through the speaker if okay.	
6. Connect the red test lead from the 1077 1 KHz jack to the input of the audio output.	
7. A louder tone should be heard if the stage is okay.	
8. Move the red test lead to the input of the 1st audio amplifier.	
9. A much louder tone will be heard if this stage is in operation.	
10. Disconnect the red test lead and move it to the audio detector. (There will be less volume.)	
11. If you have a tone through all the stages the trouble will be before the sound system.	
12. Disconnect the power and test equipment.	
13. Replace the receiver cover.	

METHOD OF EVALUATION:

1. Equipment set-up
2. Troubleshooting sequence
3. Isolation of fault

OPERATION SHEET
SC-4-35

COMPETENCY: Substitute Sound with the TV Analyst (IF Stages)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting the B & K Analyst 1077 for audio signals.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the rear cover of receiver.	. IL-4-17
2. Install isolation transformer.	. IL-4-18
3. Connect the black lead of the 1077 from ground to the receiver chassis.	. SC-4-29
	. SC-4-31
4. Connect the red test lead to the 4.5 MHz jack on the 1077.	. SC-4-33
5. Connect the other end of the red lead to the input of the audio detector.	. SC-4-34
6. Set the AUDIO-ON-OFF switch to the ON position.	
7. The 1 KHz signal tone should be heard in the speaker.	
8. Move the red test lead to the input of the sound IF amplifier stage.	
9. A louder tone should be heard in the speaker if this stage is operating okay.	
10. Move the red test lead to the input of the video detector.	
11. If the tone is still heard in the speaker, the sound trouble is in the video IF stages.	
12. Disconnect the power to the receiver and the test equipment.	NOTE: Make sure the volume control is turned up on the above steps, or no sound will come through the speaker at any time, giving a false testing of the stages.

METHOD OF EVALUATION:

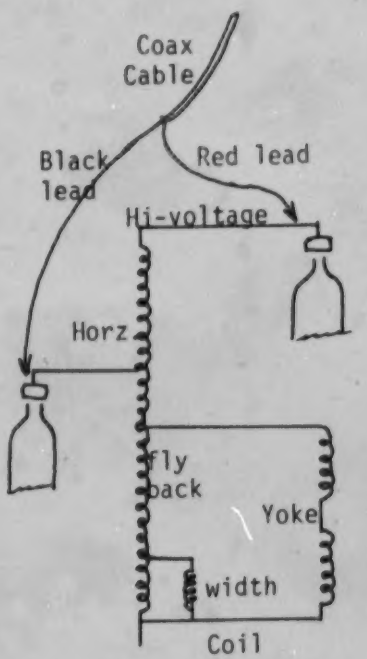
1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-36

COMPETENCY: Check the Yoke and the High Voltage Transformer with the TV Analyst

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in testing the yoke and the high voltage transformer with the TV analyst B & K 1077.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn the CALIBRATE control clockwise until the test INDICATOR lamp glows. 2. Then turn the CALIBRATE control counter-clockwise to the point where the TEST INDICATOR lamp just goes off. 3. Remove the power from the receiver. 4. Disconnect the plate caps from the horizontal output tube and the high voltage rectifier tube. 5. Connect the coax test cable to the FLYBACK YOKE TEST SIGNAL jack. 6. Clip the black lead to the horizontal cap. 7. Clip the red lead to the cap that was removed from the high voltage rectifier tube. 8. If the TEST INDICATOR lamp glows, this indicates that a short is present in the transformer or yoke circuit. 9. Disconnect the yoke and repeat the testing. 10. If short is still present, disconnect the width coil or lin coil. 11. Repeat testing until faulty component is located. 12. Disconnect the coax cable to the receiver and reconnect all parts.	. IL-4-15 . IL-4-17 

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
13. Turn the calibrate control to off position.	

METHOD OF EVALUATION:

1. Troubleshooting procedure
2. Use of test equipment
3. Location of defect

OPERATION SHEET
SC-4-37

COMPETENCY: Align Trap Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To align traps in the color TV receiver using a sweep generator.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain service literature for the receiver to be aligned.	. IL-4-18
2. Perform interconnection set-up as indicated at right.	. D-4-37
3. Connect the vertical cable to the oscilloscope vertical input.	
4. Connect the horizontal cable to the oscilloscope external output.	
5. Connect the RF output cable to the injection point in the mixer of tuner.	
6. Connect the direct probe of the 415 to the video test point of detector.	
7. Make sure the probe switch is in the direct position.	
8. Apply about 6 volts negative bias to the IF AGC line of the receiver.	
9. Place the function switch of the 415 in the MOD MKR position.	
10. Select the sound (41.25) marker frequency.	
11. Using maximum scope gain, adjust the 415 ATTENUATOR for two inch sine wave on the CRT of the scope.	
12. Locate the sound coil trap (41.25) adjustment. This is usually the top slug in the last IF transformer and is one of two coils in the same can. Use the top one only.	

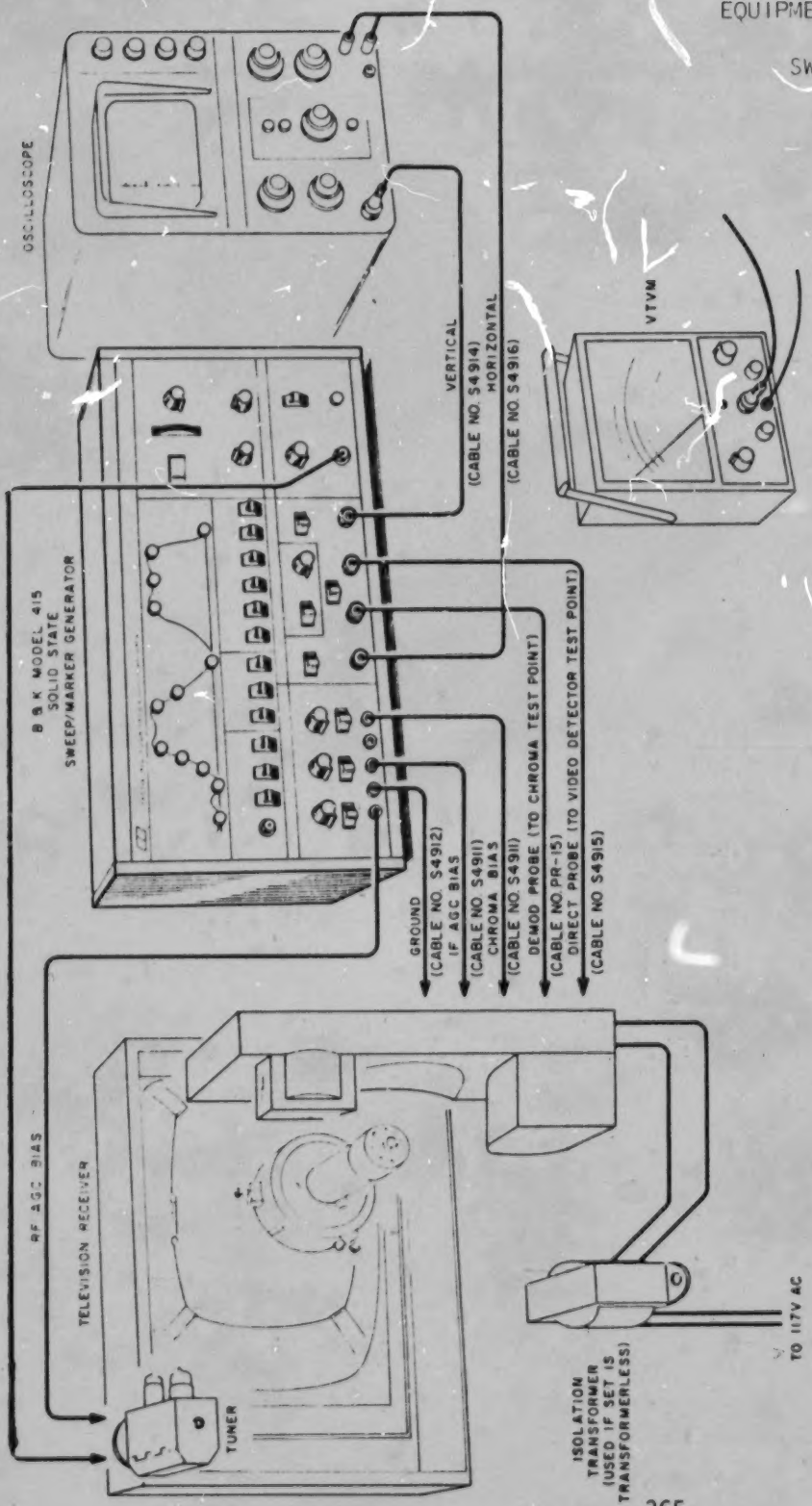
COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
13. Turn this top slug for minimum response on the CRT of the scope. Let the gain of the RF output as high as possible for response. 14. Turn off sound (41.25) marker. 15. Turn on the ADJ SND (47.25) marker switch. 16. Adjust the RF output for two inch display on the scope CRT. 17. Locate the adjacent sound trap coil which is usually located at the IF input circuit. 18. Adjust this coil for minimum CRT display of the 400 cps. 19. Turn off ADJ SND (47.25) marker. 20. Disconnect the cables to the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Test equipment set-up
3. Alignment sequence
4. Receiver performance

EQUIPMENT HOOK-UP FOR B & K 415

SWEEP GENERATOR



Equipment Interconnection

CAUTION !!

HAVE THE INSTRUCTOR CHECK YOUR SET-UP BEFORE APPLYING POWER !!

MAKE SURE THE TEST POINTS ARE THE SAME AS REQUIRED IN THE SERVICE LITERATURE

OPERATION SHEET
SC-4-38

COMPETENCY: Align the TV Tuner with a Sweep Generator

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in aligning a tuner with a sweep generator.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the test equipment.	. SC-4-37
2. Instead of test point on tuner, insert the RF signal into the tuner antenna terminals; 300 ohm setting.	. SC-4-39 . IL-4-18
3. Set the channel selector to Channel 4.	
4. Set the function switch of the 415 sweep generator to Channel 4.	
5. Adjust the fine tuning to get the best possible curve on the scope.	
6. Adjust the mixer grid for the best position of the markers.	
7. Adjust the plate of the RF amplifier for the best position of the curve.	
8. Adjust the link of the IF output for the best curve.	
9. Keep the amplitude of the curve at maximum at all times.	
10. Disconnect the equipment to the receiver.	
11. Tune a local station and check for picture and sound.	
12. Tune to a distant station and tune for best picture and sound.	
13. Disconnect the power to the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Test equipment set-up
3. Alignment sequence
4. Receiver performance

OPERATION SHEET
SC-4-39

COMPETENCY: Align the IF section with a Sweep Generator

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

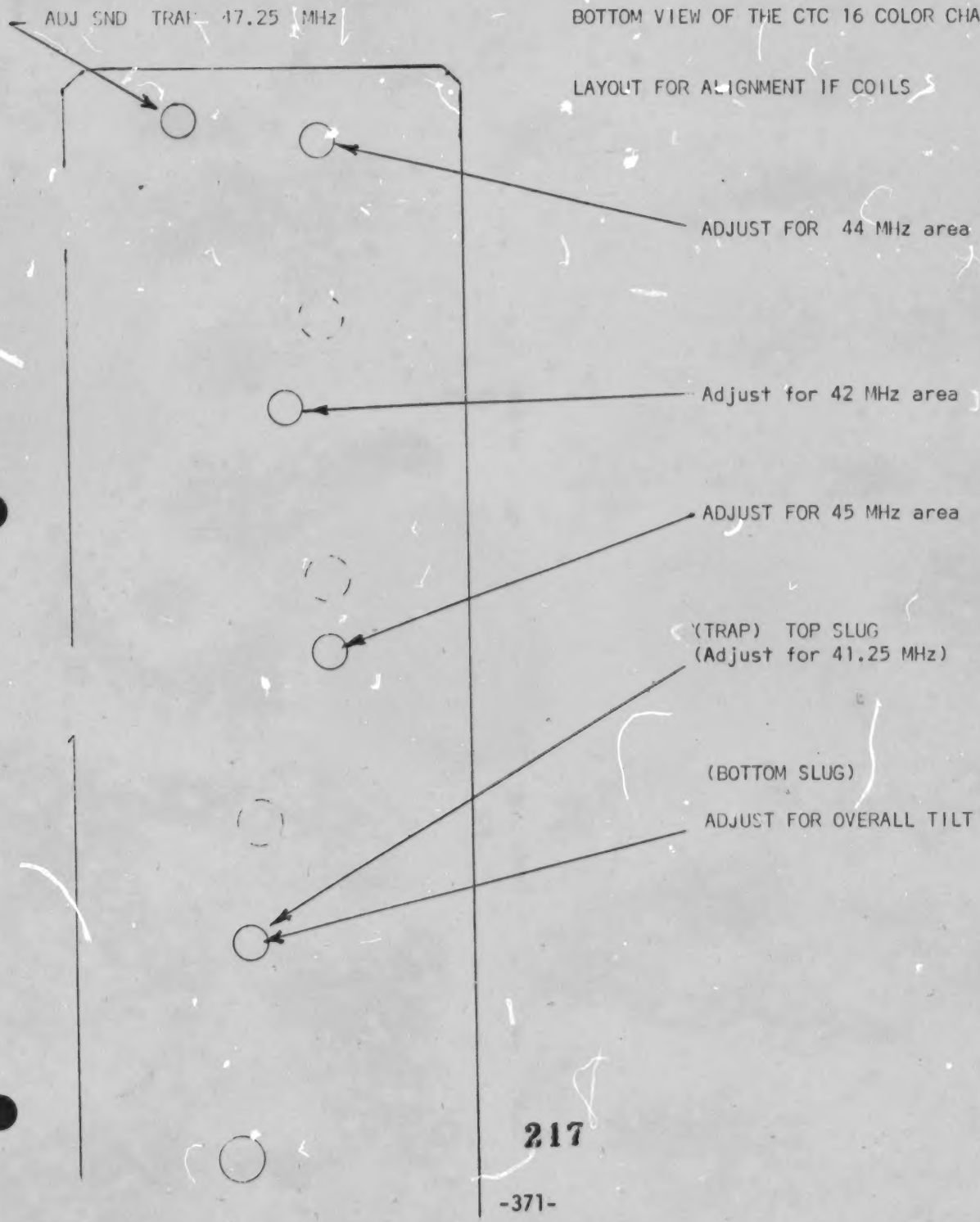
OBJECTIVE: To develop skill in aligning the IF section of a color TV receiver using the sweep generator.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain service literature for TV receiver to be aligned.	. IL-4-18
2. Perform interconnections set-up.	. D-4-37
3. Place function switch of the 415 generator to IF position.	
4. Turn on TV receiver and allow a 15 minute warm-up time.	
5. Set the RF-IF VIDEO ATTENUATOR control to mid-range.	
6. Set sweep width control to maximum clockwise direction.	
7. Set oscilloscope gain to maximum.	
8. Place probe switch to direct and turn off CHROMA switch.	
9. Turn on switches for markers; 41.25, all chroma, 45.75 and 47.25.	
10. Use the hex type alignment tool and turn the slugs slowly in the coil for response curve, as shown on the front of the 415 generator.	
11. Adjust the first IF coil for the 44 MHz area of the curve.	. D-4-39
12. Adjust the second IF coil for the 45.75 MHz area of the curve.	
13. Adjust the third IF coil for the 43.80 MHz area of the curve or overall tilt of the curve. (This is the bottom slug.)	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
14. The tuner output coil is also a part of the IF circuit; this may have to be adjusted for tilt of curve. 15. Adjust for correct curve shape and keep it as high as possible of scope. 16. Compare the scope curve with that on the front of the 415. 17. Do not overload the receiver; use as little output as possible from the 415 generator. 18. Repeat the adjustments from the first to the third IF until the curve is as close as possible to the front of 415.	NOTE: When finished with the alignment, turn off power and disconnect the cables from TV.

METHOD OF EVALUATION:

1. Use of service data
2. Test equipment set-up
3. Alignment sequence
4. Receiver performance


ADJ SND TRAP 47.25 MHz
BOTTOM VIEW OF THE CTC 16 COLOR CHASSIS
LAYOUT FOR ALIGNMENT IF COILS
ADJUST FOR 44 MHz area
Adjust for 42 MHz area
ADJUST FOR 45 MHz area
(TRAP) TOP SLUG
(Adjust for 41.25 MHz)
(BOTTOM SLUG)
ADJUST FOR OVERALL TILT

OPERATION SHEET
SC-4-40

COMPETENCY: Check the Overall Response Curve

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in checking the overall response curve.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain service literature for the receiver to be aligned.	. IL-4-18
2. Hook-up as indicated at right.	. SC-4-37
3. Replace all defective tubes, transistors and parts before alignment check.	
4. Turn on power to receiver and test gear.	
5. At this point, the technician must analyze the overall IF curve.	
6. Compare the curve on the scope with that on the front of the B & K 415.	
7. Make certain that each marker frequency is in the proper position.	
8. When doing a touch-up alignment, the traps should be nulled first (min gain).	
9. Adjust trap.	. SC-4-37
10. Touch-up all IF coils needed to give the proper curve size and the correct placement of the markers on the curve.	
11. Be sure to check the sound alignment if you have to turn the coil slugs very far.	
12. Turn on the 41.25 and 45.75 markers only for the sound alignment.	. SC-4-39

METHOD OF EVALUATION:

1. Use of service data
2. Test equipment set-up
3. Alignment sequence
4. Receiver performance

OPERATION SHEET
SC-4-41

COMPETENCY: Adjust the 3.58 MHz Oscillator

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting the 3.58 MHz Oscillator

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the color bar generator to the receiver antenna terminals.	. IL-4-20
2. Tune the receiver and the generator to Channel 4.	
3. Remove the receiver back cover.	
4. Apply power to the receiver and color bar generator.	
5. Connect the DC volt meter to the input of the phase detector.	
6. Adjust the 3.58 MHz oscillator plate tank slug for maximum meter reading.	
7. Ground the grid of the reactance tube.	
8. Adjust the plate coil slug in the reactance tube circuit so the bars just stand still.	
9. A small amount of floating will occur of the color bars.	
10. Remove the short to ground, and the color bars should stop floating and have the correct color in the proper bar (3rd bar red, 7th bar blue).	
11. If the colors are not correct or the bars don't stand still, repeat steps 7-10.	
12. If a tube in the oscillator is weak, it may cause floating of the bars.	

COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
13. If the crystal in the 3.58 oscillator is aged, it also may cause a floating of frequency. 14. Start adjustment first, and if it does not stabilize, change the tube and crystal.	

METHOD OF EVALUATION:

1. Use of service data
2. Test equipment set-up
3. Alignment sequence
4. Receiver performance

OPERATION SHEET
SC-4-42

COMPETENCY: Substitute Color Signal in the Color Circuits (Chroma)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in substituting color signals in the chroma section of the color receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove the rear cover of the receiver.	. IL-4-19
2. Set the color control to 10.	. IL-4-20
3. Connect the black lead to the chassis.	. IL-4-41
4. Connect the red lead from the COLOR jack to the color demodulator.	
5. If color bars appear on the screen, they may be out of sync.	
6. If color bars appear in step 4 inject red lead to the output of the color bandpass amplifier.	
7. If color bars appear in step 6, inject red lead to input of the color amplifier.	
8. If color bars appear on screen, inject red lead to input of the color amplifier.	
9. If color bars appear, move red lead to color take-off point after the video amplifier.	
10. Color bars may be out of sync; that is, the bars may look like a barber pole and keep moving.	
11. Disconnect the color bar generator.	
12. Replace the rear cover on the television.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Correction of fault
4. Receiver performance

OPERATION SHEET
SC-4-43

COMPETENCY: Align Chroma Bandpass

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in aligning chroma bandpass circuits with the sweep generator.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain service literature for set to be aligned.	. IL-4-18
2. Perform interconnections set-up.	. SC-4-37
3. The technician should perform the IF video alignment before this one.	. SC-4-39
4. Place the CHROMA switch to the DEMOD position.	
5. Set the PROBES switch to the DEMOD position.	
6. Connect the demodulation probe to the color control on the receiver (high side).	
7. Turn on the markers: 41.25, 41.67, 42.17 and 42.67 MHz.	
8. Adjust the sweep width control and the center frequency control to reduce and center on the scope of the curve.	
9. Adjust the marker amplitude control for proper size marker display on scope.	
10. Adjust the attenuator control for a proper size curve in height.	
11. Adjust the 1st and 2nd bandpass coil slugs for proper curve and placement of markers on the oscilloscope screen.	
12. Compare the curve on the front of the 415 with the curve on the scope screen.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
13. Adjust the slugs to get the best possible curve and marker placement. 14. Reduce the output of the 415 and touch-up the slugs for proper response curve. 15. Make sure the bias is proper for set under alignment. 16. Disconnect all the test leads and give the receiver an air check for color reception. 17. Disconnect the power.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Correction of fault
4. Receiver performance

OPERATION SHEET
SC-4-44

COMPETENCY: Align Chroma Sync Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in aligning chroma sync circuits.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain service literature for set to be aligned.	. IL-4-19
2. Connect the color bar generator to the receiver antenna terminals.	. IL-4-20
3. Connect the VTVM to the phase detector.	. SC-4-43
4. Set the tint control to the center of its range.	
5. Make sure the color killer control is turned all the way counterclockwise.	
6. Adjust the color oscillator (3.58 MHz) for maximum VTVM reading (oscillator plate coil).	
7. A scope can be used instead of the VTVM for peaking the oscillator plate coil.	
8. Adjust the phase detector transformer for maximum reading on the VTVM or scope.	
9. Remove the VTVM or scope.	
10. Ground the reactance tube input.	
11. Adjust the reactance tube plate coil slug for zero beat.	
12. Zero beat is the color bars standing still or drifting slowly on the screen.	
13. Remove the ground from the reactance tube.	
14. Check the tint control to make sure the color bars are correct color; if not, touch-up the phase transformer adjustment.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Correction of fault
4. Receiver performance

COMPETENCY: Service ACC Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop an understanding of how to service ACC Circuits.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove television cover.	. IL-4-19
2. Apply power to receiver.	. IL-4-20
3. Turn color killer all the way counterclockwise.	. SC-4-43
4. Adjust the chroma control to the center of its range.	. SC-4-44
5. Tune receiver for normal reception of color program.	
6. Turn ACC switch to OFF position.	
7. Watch screen and turn the chroma control from lowest to highest setting.	
8. Color should get brighter at the highest setting.	
9. At the highest setting of the chroma, control switch the ACC switch to ON.	
10. The color should drop off from the highest setting to decent level for viewing.	
11. If color does not change in brightness or if it goes away completely, change the transistor for ACC.	
12. If the color killer is transistor, change it also.	
13. Disconnect the power to the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Correction of fault
4. Receiver performance

OPERATION SHEET
SC-4-46

COMPETENCY: Remove and Replace a Color Kinescope (Picture Tube)

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in removing a color picture tube from the cabinet to be able to replace a new unit.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Wear safety goggles when performing this operation.	. IL-4-21
2. Remove the chassis.	. SC-4-1
3. Unplug and unbolt the convergence chassis from the cabinet and remove the blue lateral assembly from tube neck.	
4. Loosen the deflection yoke clamp and remove the yoke from the neck of the tube.	
5. Remove the picture tube shield by removing the hex head bolt at each corner of the tube.	
6. Leave the grounding spring attached.	
7. Remove the four hex head bolts securing the four picture tube mounting brackets to mask.	
8. Using the mounting brackets as hand holds, lift the picture tube assembly from cabinet, placing it face down on a protective pad.	
9. Loosen the mounting strap from the picture tube and lift the assembly from the tube.	
10. Remove the felt pads from the picture tube.	
11. Open box with new tube in it.	

METHOD OF EVALUATION:

1. Safety precautions
2. Use of service data
3. Disassembly procedure
4. Replacement sequence
5. Receiver performance

OPERATION SHEET
SC-4-47

COMPETENCY: Adjust the Static and Dynamic Convergence

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop an understanding in adjusting the static or dynamic convergence on the color receiver picture tube.

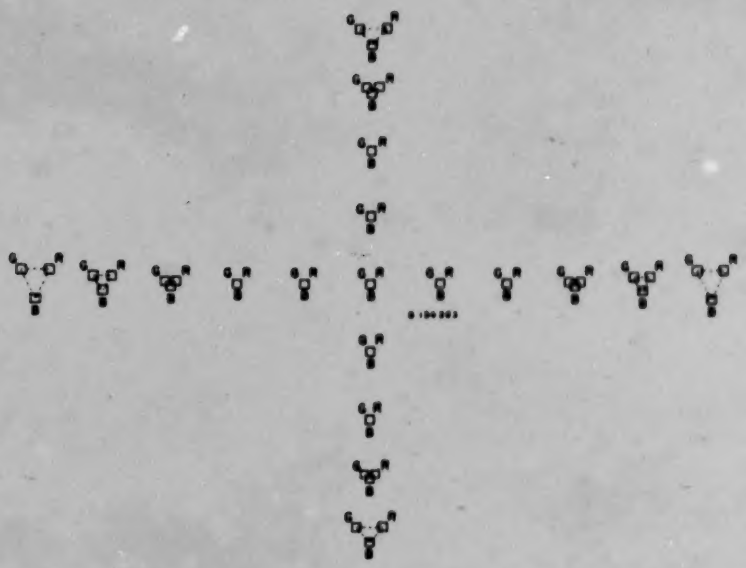
COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect the dot/bar generator to the receiver.	. IL-4-23
2. Adjust the receiver for proper black and white.	. SC-4-2
3. Focus and electrical centering must be adjusted at this time.	
4. Demagnetize the color tube with the degaussing coil.	. SC-4-51
5. Loosen the clamp on the deflection yoke and move as far back as possible.	
6. Shunt the blue and green picture grids through a 100K ohm resistor each to ground.	
7. Turn the receiver power on.	
8. Adjust the red grid for bright red screen.	
9. Rotate the purity tabs until a uniform red center area appears in the screen.	
10. Move the yoke forward until the entire screen is a uniform red without neck shadows.	
11. Remove the shunt from the blue and green grids.	
12. Check the blue and green screen for neck shadows; readjust the red purity if necessary.	
13. Turn the blue screen off and the red and green screen for normal brightness.	

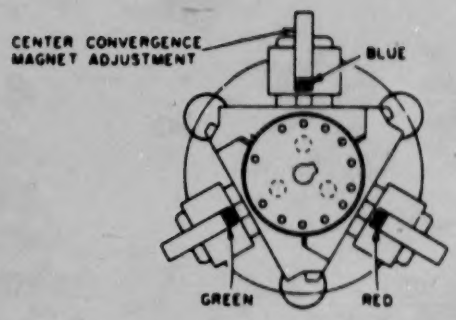
COMPETENCE - PROCEDURES/STEPS	TEACHING/LEARNING ACTIVITIES
14. Adjust the convergence magnets for a yellow dot at the center of the screen. 15. Turn the blue screen up and adjust for a white dot at the center of the screen with the lateral magnet and the convergence magnet for the blue. 16. Recheck the dot pattern and readjust the static controls for a good center convergence. 17. Disconnect the generator. 18. Disconnect the power to the receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Receiver performance

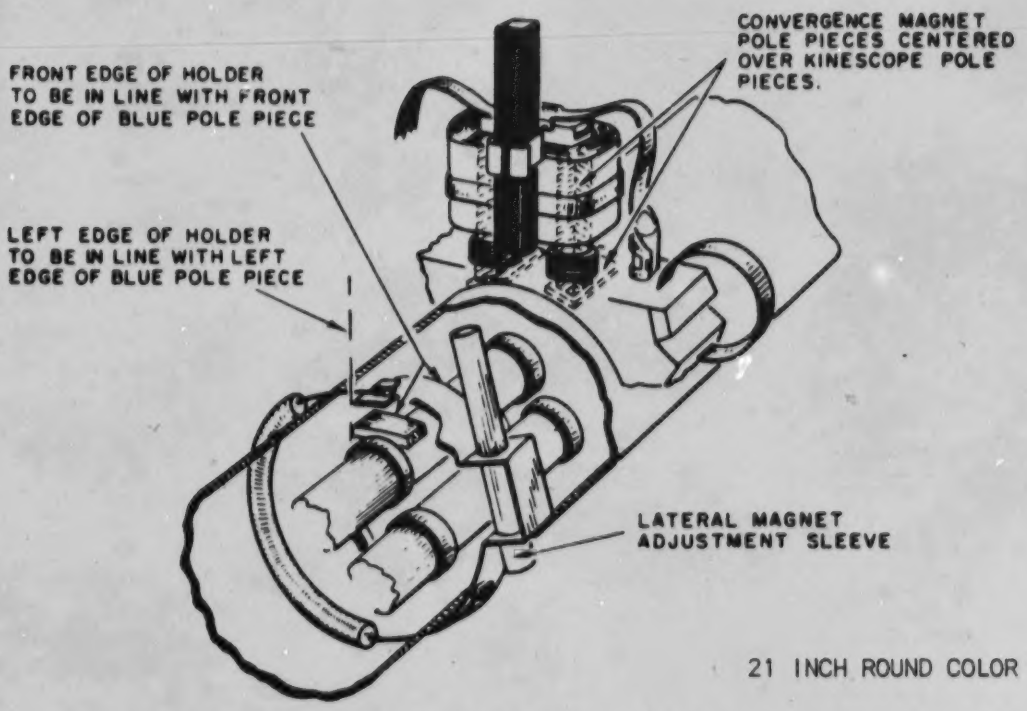
COMPETENCY: Adjust Static Convergence Drawing SC-4-47A



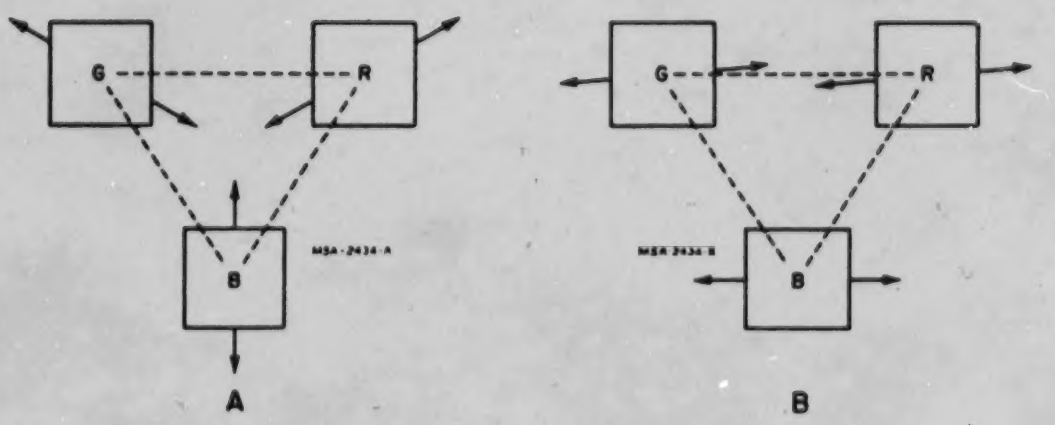


COMPETENCY: ADJUST STATIC CONVERGENCE

Drawing SC-4-478


CONVERGENCE MAGNET POLE PIECES CENTERED OVER KINESCOPE POLE PIECES.
FRONT EDGE OF HOLDER TO BE IN LINE WITH FRONT EDGE OF BLUE POLE PIECE
LEFT EDGE OF HOLDER TO BE IN LINE WITH LEFT EDGE OF BLUE POLE PIECE
LATERAL MAGNET ADJUSTMENT SLEEVE

21 INCH ROUND COLOR TUBE

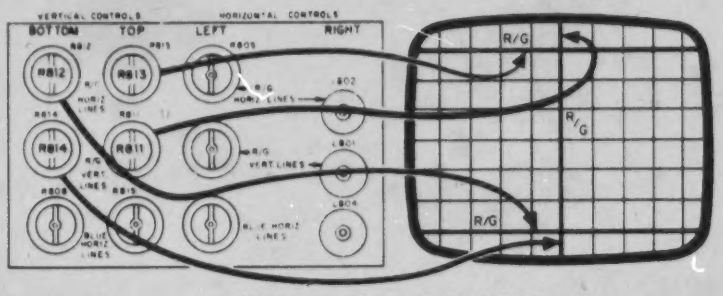


Dot Movement Pattern

230

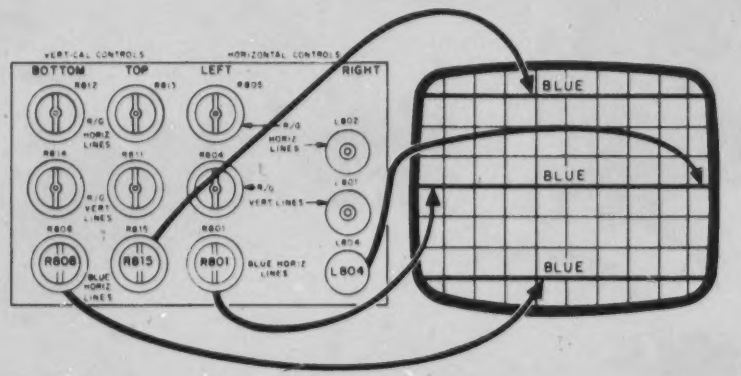
DYNAMIC CONVERGENCE

1. Use either crosshatch or dot pattern for center converge.
2. Converge center of screen with red, green, and blue magnets and the blue lateral magnet.
3. Adjust R811 and R814 for convergence (parallelism) of R/G vertical center line.
4. Readjust center convergence if necessary.
5. Adjust R812 to converge bottom R/G horizontal lines and R813 to converge top R/G horizontal lines at center line of screen.
6. Adjust R801 and L804 for straight horizontal blue center line.
7. Adjust R808 and R815 for uniform displacement of blue horizontal lines along center vertical lines.
8. Converge blue horizontal lines with R/G horizontal lines by adjusting the blue convergence magnet. Adjust red and green magnets if necessary.
9. Repeat steps 6 through 8 if necessary.
10. Adjust alternately L801 and R804 for right and left side convergence of R/G vertical lines.
11. Adjust alternately L802 and R805 for convergence of R/G horizontal center line.
12. Converge center of screen and repeat steps 10 and 11 if necessary.
13. Minor touch up adjustments may be made using the appropriate controls. If wide blue correction is necessary, loosen yoke and adjust wide blue correction screw. If wide blue correction is adjusted, purity must be rechecked.



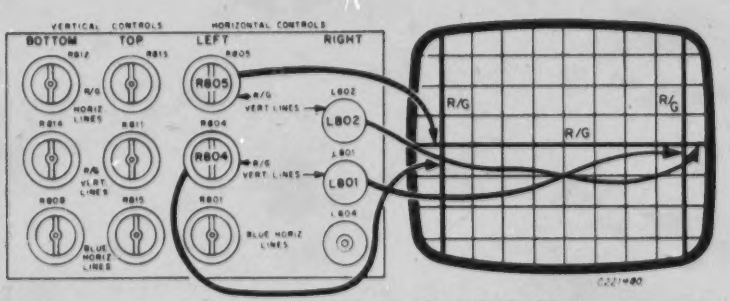
STEPS 3 AND 5 ADJUSTMENTS

Effect of R811, R812, R813 and R814 Adjustment



STEPS 6 AND 7 ADJUSTMENTS

Effect of R801, L804, R808 and R815 Adjustment



STEPS 10 AND 11 ADJUSTMENTS

Effect of L801, R804, L802 and R805 Adjustment

OPERATION SHEET
SC-4-48

COMPETENCY: Adjust Temperature of a Color CRT

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting the temperature of the color CRT.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set all screen controls to minimum.	. IL-4-21
2. Set all drive controls to maximum.	. IL-4-23
3. Set the kinescope bias control to mid-position.	
4. Set the brightness control to maximum.	
5. Set the contrast control to mid-position.	
6. Position service switch to service position.	
7. Advance the screen controls until screen just lights.	
8. Position service switch to raster and adjust the drive controls for Kelvin gray.	
9. Check the brightness level from low to high for good gray tracking.	NOTE: Gray does not change from high to low brightness.

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Receiver performance

OPERATION SHEET
SC-4-49

COMPETENCY: Adjust Focus and High Voltage in a Color TV Receiver

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in adjusting the focus and high voltage in a color TV receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply power to receiver.	. IL-4-21
2. Check high voltage with high voltage meter.	
3. Set brightness control to minimum.	
4. Adjust high voltage control for required voltage on service literature (about 25 KV).	
5. Set brightness control to light CRT screen.	
6. Adjust focus control until raster lines are as small and sharp as possible.	
7. Lower brightness control and screen light level.	
8. Recheck focus setting on raster lines.	
9. Remove power receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing sequence
3. Receiver performance

OPERATION SHEET
SC-4-50

COMPETENCY: Repair and Align Automatic Tuning Circuits

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in repairing and aligning AFT Circuits

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply power to receiver.	. IL-4-26
2. Tune local station for good picture and sound.	. IL-4-27
3. Check meter on AFT output.	
4. Adjust hex slugs for correct voltage on AFT output connection (about 5 volts).	
5. Remove power from receiver.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing techniques
3. Receiver performance

OPERATION SHEET
SC-4-51

COMPETENCY: Degauss a Color CRT

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in degaussing a Color CRT.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply power to set.	. IL-4-21
2. Bring degauss coil in front of receiver.	
3. Move degauss coil around CRT face slowly.	
4. Continue to rotate coil slowly and move away from face of CRT at least ten feet.	
5. Remove power from coil, insuring that the coil is at least ten feet from face of CRT.	

METHOD OF EVALUATION:

1. Use of equipment
2. Degaussing technique
3. Receiver performance

OPERATION SHEET
SC-4-52

COMPETENCY: Use the Color Bar Generator

COURSE: Radio and Television Repair UNIT IV: Television and Video Systems Analysis and Troubleshooting

OBJECTIVE: To develop skill in using the color bar generator (B & K 1077).

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect generator to antenna terminals.	. IL-4-19
2. Apply power to generator and color receiver.	. IL-4-20
3. Set channel selection to Channel 3 or receiver and generator.	
4. Set color control on receiver to mid-position.	
5. Set chroma control on generator to mid-position.	
6. Adjust function switch on generator to bars.	
7. While observing CRT on receiver, adjust receiver tint control.	
8. Color bars should change position while adjusting tint control.	
9. Remove power from receiver and generator.	
10. Disconnect generator.	

METHOD OF EVALUATION:

1. Use of service data
2. Servicing techniques
3. Receiver performance

OPERATION SHEET
SC-5-1

COMPETENCY: Unpack Television Receiver

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To unpack a television receiver without damage.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Carefully place television carton bottom-side up in open area. 2. Remove all staples holding bottom carton flaps. 3. Fold out the four bottom flaps. 4. While holding flaps extended turn carton right-side up. 5. Lift carton from television receiver. 6. Remove miscellaneous packing. 7. Make sure warranty cards and instruction manuals are not discarded with carton and packing.	. IL-5-1

METHODS OF EVALUATION:

1. Sequence of unpacking
2. Correct handling techniques

COMPETENCY: Check for Proper Picture Adjustments

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To make all picture tuning adjustments on television receiver

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect color bar generator to television receiver antenna terminals.	. SC-4-47
2. Set generator for cross-hatch output.	. SC-4-48
3. Tune television receiver to output frequency of generator.	
4. Adjust centering rings or controls to center picture.	
5. Adjust vertical linearity and height controls for equal spacing of blocks vertically.	
6. Adjust focus for fine line presentation on screen.	
7. Adjust AGC threshold.	
8. Adjust horizontal frequency control.	
9. Remove color bar generator and connect antenna to receiver.	
10. Adjust fine tuning control on each operational television channel.	
11. If necessary, adjust local oscillator tuner plugs on VHF channels.	
12. Reset AGC control for each used channel.	

METHOD OF EVALUATION:

Observe television picture.

OPERATION SHEET
SC-5-3

COMPETENCY: Check for Proper Color Adjustments

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To adjust and balance color alignments on a television receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect color bar generator to television antenna terminals. Tune in generator on television channel selector. Set generator to cross-hatch output.	. SC-4-42 through SC-4-45 . SC-4-47 . SC-4-48
2. Move television "SET UP" switch to purity position.	
3. Turn up red screen control;turn down blue and green screens.	
4. Check for pure red field.	
5. Degauss, if necessary.	
6. Adjust purity rings and yoke.	
7. Check green and blue fields.	
8. Move set-up switch to "SET UP."	
9. Adjust red, green, and blue screens for BW trace.	
10. Move set up switch to restore normal operation.	
11. Check convergence with cross hatch pattern.	
12. Adjust static convergence.	
13. Adjust dynamic convergence.	
14. Adjust black-white tracking.	
15. Adjust color killer threshold.	

METHOD OF EVALUATION:

Observe for proper picture adjustment.

OPERATION SHEET
SC-5-4

COMPETENCY: Instruct Customer on Set Operation

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To instruct a customer on correct television receiver operation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Demonstrate use of fine tuning and channel selector controls. 2. Demonstrate use of AFC switch. 3. Show operation of color level and tint controls. 4. Demonstrate remaining customer preference controls. 5. Show significance of antenna rotor position or position of indoor antenna azimuth or position.	. IL-5-2 . IL-5-3 . IL-5-6 . IL-4-27

METHOD OF EVALUATION:

Instructor will assume role of receiver customer and evaluate student performance.

OPERATION SHEET
SC-5-5

COMPETENCY: Survey for Antenna Installation Site

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To conduct a site survey for a television antenna installation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use a mobile antenna to probe the area for signal strength and reflections. 2. Estimate the length of runs required for: a. transmission lines b. rotor cable c. ground wire. 3. Determine type of antenna for signal strength and ghost elimination. 4. Determine type of antenna mount-chimney or wall mount. 5. Locate grounding point. 6. Make a list of all materials required. 7. List special equipment required.	. IL-5-4 through IL-5-8

METHOD OF EVALUATION:

Student will write a survey report.

OPERATION SHEET
SC-5-6

COMPETENCY: Select the Antenna

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To select an antenna that will give the best performance for a given site.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Probe the area for signal strength and reflections with a test antenna and television receiver.	. IL-5-4 through IL-5-6 . IL-5-8
2. Connect several antennas to test receiver to determine picture quality and color rendition along with ghost rejection.	
3. Select that antenna which produces optimum picture.	

METHOD OF EVALUATION:

Student will write a report on television antenna selection.

COMPETENCY: Install and Orient the Antenna

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To correctly install a television antenna and orient it for best signal reception.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. On the ground--connect chimney mount to brackets with hardware.	. IL-5-4 through IL-5-7
2. On the roof--secure chimney mount straps to chimney or bolt on wall mount.	
3. On the ground--install one 5' mast section into rotor motor--connect rotor cable to motor terminals and seal.	
4. On the roof--install this 5' mast section and rotor into chimney mount or wall bracket. Tighten bolts.	
5. On the ground--extend antenna and bolt it to another 5' mast section. Connect transmission line to antenna and feed through one mast stand-off insulation. Spray connections with weatherproof plastic.	
6. On the roof--install antenna and mast into rotor motor--orient antenna due north. Tighten clamps.	
7. Install mast stand off insulators.	
8. Connect ground wire to mast.	
9. Run transmission line--rotor cable--ground wire with wall stand offs down side of building.	
10. Clamp ground wire to ground stake or cold water pipe.	
11. Connect transmission line to television receiver.	
12. Connect rotor cable to rotor control box.	
13. Install lightning arrestor.	

METHOD OF EVALUATION:

Check television installation on mock chimney in shop.

OPERATION SHEET
SC-5-8

COMPETENCY: Install an Antenna Rotor

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performence Analyais

OBJECTIVE: To install an antenna rotor and remote control.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. On the ground--connect rotor cable to rotor motor connectors. Make connection to control box. Check operation. Disconnect from control box.	. IL-5-7
2. Insulate with plastic spray.	
3. Seal connector panel.	
4. Mount rotor to 5' mast section.	
5. On the roof--install mast and rotor into chimney mount or wall bracket.	
6. Run rotor cable to rotor control box.	
7. Connect rotor cable to rotor control box.	
8. Recheck rotor operation.	

METHOD OF EVALUATION:

Check rotor installation on mock chimney in shop.

OPERATION SHEET
SC-5-9

COMPETENCY: Install Transmission Wire

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To install transmission wire from antenna to receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Route and lay cable from antenna to receiver.	. IL-5-9
2. Determine cable clamp locations.	. IL-5-11
3. Select correct size cable clamp.	. IL-5-12
4. Keep cable tight on mast or walls and attach clamp.	
5. If masonry wall, drill for lag shield.	
6. Insert lag shield.	
7. Place screw through clamp and cable.	
8. Secure screw through clamp to shield.	
9. Pull cable tight and tighten screw and clamp.	
10. Continue installation of clamps until completed.	

METHOD OF EVALUATION:

1. Cable routing
2. Cable clamped securely without sags
3. Correct signal reception at receiver

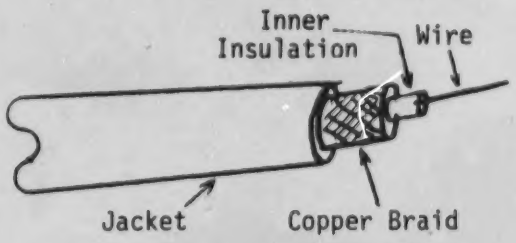
OPERATION SHEET
SC-5-10

COMPETENCY: Attach Coaxial Fittings

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To correctly install coaxial fittings on coaxial cable.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select proper size coaxial fitting.	. IL-5-11
2. Remove outside vinyl jacket with cutters.	. IL-5-12
3. Strip off about one and one-half inches of vinyl jacket.	
4. Cut off copper braid one-half inch from jacket.	
5. Remove inside insulation with cutter; be sure not to nick inner copper wire.	
6. Remove inside insulation 5/8" from jacket.	
7. Install sleeve of fitting on cable; make e sure correct end first.	
8. Screw fitting body on to cable end.	
9. Screw sleeve onto body of fitting.	
10. Solder inner wire to fitting.	



METHOD OF EVALUATION:

1. Check mechanical strength of fitting on cable.
2. Test for continuity and/or electrical short circuits.

OPERATION SHEET
SC-5-11

COMPETENCY: Calculate RF Distribution Losses

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To determine RF distribution losses in a cable installation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure cable length.	. IL-5-13
2. Record db loss for Channel 13 from charts per foot basis.	. IL-5-14
3. Count splitters in longest cable run.	
4. Add splitter loss to cable loss.	
5. Count tap-offs on longest cable run.	
6. Add tap-off insertion loss to cable and splitter losses.	
7. Add isolation tap-off loss to system.	EXAMPLE:
	Cable loss 10.0 db Splitter loss 6.0 db tapoff inseration loss 0.7 db tapoff isolation loss 17.0 db Total loss 33.7 db

METHOD OF EVALUATION:

Check accuracy of calculations.

OPERATION SHEET
SC-5-12

COMPETENCY: Select a Distribution Amplifier

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To use antenna parameters to select a distribution amplifier.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure the antenna gain with an RF strength meter.	
2. Calculate RF distribution losses.	. SC-5-11
3. Subtract antenna gain from cable loss.	
4. Select amplifier by db rating on output per channel.	
5. Select amplifier that will give at least 10% more gain than the difference shown in step three.	

METHOD OF EVALUATION:

Check reading on RF field strength meter and accuracy of calculations.

OPERATION SHEET
SC-5-13

COMPETENCY: Install a Distribution Amplifier

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To install, test and adjust a distribution amplifier.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select mounting site as close to antenna as possible. 2. Mount amplifier securely to mast or wall. 3. Weatherproof the amplifier as required. 4. Connect cable with correct fitting to input and output of amplifier. 5. Measure gain with an RF field strength meter. 6. Check for correct AC power. 7. Adjust levels as required by meter readings in step 5 above.	. IL-5-13 through SC-5-15

METHOD OF EVALUATION:

1. Installation procedures
2. Test procedures
3. Correct amplifier output

OPERATION SHEET
SC-5-13

COMPETENCY: Install Signal Distribution Boxes

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To install signal distribution boxes.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select mount for distribution box.	. IL-5-16
2. Prepare cable for connecting to the box. a. Strip coax cable (½" vinyl jacket). b. Remove copper braid. c. Strip inner insulation. (Don't nick wire.)	. SC-5-10
3. Slip retaining crimp ring on cable.	
4. Insert cable to input of box.	
5. Crimp ring with crimping tool.	
6. Mount box to wall with wood screws that came with box.	
7. Measure signal at box with RF meter.	

METHOD OF EVALUATION:

1. Correct installation practices
2. Measure signal output of box.

OPERATION SHEET
SC-5-15

COMPETENCY: Install Line Tap-off

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To install line tap-offs for signal separation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Screw mount body to cable with screws supplied (#14 nut driver).	. IL-5-16
2. Insert cutting tool supplied with tap-off and remove outside wire and jacket.	
3. Remove cutting tool from mount body.	
4. Clean mount body with solder aid.	
5. Select proper isolation inset and screw into tap-off body.	
6. Prepare tap-off cable (RG 59/U).	. SC-5-14
7. Slip crimp ring on cable.	
8. Insert cable into tap-off insert.	
9. Crimp ring with crimping tool.	

METHOD OF EVALUATION:

Correct installation procedures

OPERATION SHEET
SC-5-16

COMPETENCY: Install Signal Splitters

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To install a signal splitter to permit operation of more than one receiver from a single signal input.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the splitter for number of sets to be operated.	. IL-5-17
2. Select the splitter mounting location, based on location of sets to be operated.	
3. Mount the splitter with wood screws or appropriate fasteners for the mounting surface.	
4. Prepare cables for installation to the splitter:	. IL-5-12
a. Strip coax cable (½" vinyl jacket).	. SC-5-10
b. Remove copper braid.	
c. Strip inner insulation.	CAUTION: Don't nick the center wire.
5. Slip retaining crimp rings on cables.	
6. Insert cables into connectors or input and output of splitter.	
7. Crimp retainer rings with crimping tool.	
8. Check receiver performance to insure signal levels.	

METHOD OF EVALUATION:

1. Selection of splitter
2. Mounting procedures
3. Individual receiver performance.

OPERATION SHEET
SC-5-17

COMPETENCY: Measure Signal Levels and Loss

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To determine acceptable signal levels in a cable television system.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Connect field strength meter to system. 2. Check stations available on cable. 3. Record db reading of each channel on cable. 4. Disconnect meter from cable.	. IL-5-13 . IL-5-14

METHOD OF EVALUATION:

1. Equipment use
2. Signal evaluation

OPERATION SHEET
SC-5-18

COMPETENCY: Analyze Receiver Malfunction

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To develop a sequence for analyzing television receiver malfunctions.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Plug receiver into isolated AC outlet.	. IL-5-19
2. Attach antenna.	
3. Turn on receiver.	
4. Select channel and fine tune for best picture and sound.	
5. Adjust volume, contrast and brightness control and observe for correct operation.	
6. Adjust vertical and horizontal hold for correct operation.	
7. Adjust height, linearity, focus, AGC and other rear apron controls for correct operation.	
8. Write job report noting any difficulties encountered with set operation.	

METHOD OF EVALUATION:

Check job report for correct analysis.

OPERATION SHEET
SC-5-19

COMPETENCY: Determine Receiver Malfunction

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To troubleshoot a malfunctioning television receiver.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove back from television receiver.	. IL-5-20
2. Connect AC jumper cord to receiver.	
3. Attach antenna to correct terminals.	
4. Turn on receiver and observe for sound and picture.	
5. After observation determine stage or stages malfunction is related to.	
6. Perform all in-cabinet television repair procedures.	
7. Remove chassis and use available test equipment to pinpoint malfunction to correct stage.	
8. Write job report on television receiver.	

METHOD OF EVALUATION:

1. Correct troubleshooting sequence.
2. Check job report for determination of malfunctioning stage.

OPERATION SHEET
SC-5-20

COMPETENCY: Analyze an Intercom/Music System Failure

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To locate and repair malfunctioning intercom/music system components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn on system and observe any visual or audio problem. 2. If system has audio, check remote speaker operation. 3. If system is dead, remove chassis from enclosure. 4. Connect AC jumper cord and check system master for stage malfunction. 5. Repair stage malfunction and connect master. 6. Check system for correct master and remote speaker operation. 7. Write job report on repairs made.	. IL-5-20 . IL-5-21

METHOD OF EVALUATION:

1. Troubleshooting procedures
2. Repair practices
3. Correct performance

OPERATION SHEET
SC-5-21

COMPETENCY: Install Audio Wiring

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To layout and install wiring for an audio system.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain a wiring diagram necessary to complete an audio system with master and remote units.	. IL-5-15 . IL-5-21
2. Survey system for routing of wire. Observe any areas where wire may cross power sources and reroute wire or isolate from power injection.	
3. Select correct wire for installation.	
4. Measure wire necessary for job.	
5. Route and attach wire from master to remote units.	
6. Connect wire to units and check system for operation.	
7. Inspect completed job for wire concealment, safety and neatness.	

METHOD OF EVALUATION:

Inspect system for correct installation and operation.

OPERATION SHEET
SC-5-22

COMPETENCY: Install Audio and Television Wiring

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To layout and install wiring for multiple system components.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Inspect site and determine receivers that have to be connected. 2. Obtain necessary antenna lead-in wire to complete job; i.e., 300 Ohm or coaxial cable. 3. Determine and cut correct length of wire necessary to complete job. 4. Route wire from coupler to individual receivers. Conceal and keep wire attached snugly, where possible. 5. Connect wires to coupler and receiver making sure that no electrical shorts occur. 6. Turn on receiver and check reception.	. IL-5-9 through IL-5-11 . IL-5-15 through IL-5-18

METHOD OF EVALUATION:

1. Layout and cable routing
2. Individual component operation

OPERATION SHEET
SC-5-23

COMPETENCY: Test an Intercom/Music System

COURSE: Radio and Television Repair

UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To check out an audio system for correct operation.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn system on.	. IL-5-19
2. Check master unit for audio output.	. IL-5-34
3. Increase volume and check for audio distortion.	. IL-5-37 through IL-5-39
4. Turn to radio receiver position and check for reception. Track complete dial.	
5. Check operation of each remote speaker for distortion and operation with master.	
6. Write job report on system operation.	

METHOD OF EVALUATION:

Check operation report for detail and correctness.

OPERATION SHEET
SC-5-24

COMPETENCY: Install Speakers and Speaker Enclosures

COURSE: Radio and Television Repair UNIT V: Systems Maintenance, Repair and Performance Analysis

OBJECTIVE: To survey and install speakers and enclosures to produce desired audio results.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Survey site for speaker placement.	. IL-5-20 through IL-5-23
2. Check surface for mounting and ability to hold speaker enclosure. Observe vibration effect.	. IL-5-33
3. Mount speakers in enclosures with correct hardware.	
4. Connect wires to speakers and then solder to terminals.	
5. Mount enclosures to selected surface with correct hardware.	
6. Check operation for vibration, distortion and feedback and correct as necessary.	

METHOD OF EVALUATION:

1. Neatness
2. Correct procedures
3. Equipment operation

OPERATION SHEET
SC-6-1

COMPETENCY: Fill Out a Repair Order

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To complete a repair order form accurately.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain a repair order form. 2. Check repair order form and note all places that form has to be completed. 3. Fill out the work order form using your own name, address, phone, date, and simulated radio-television problem. 4. Obtain a list of sample names and problems from the instructor. 5. Complete five sample work order forms.	. IL-6-1 . IL-6-7 . IL-6-10

METHOD OF EVALUATION:

1. Check forms for completeness.
2. Check forms for accuracy.

OPERATION SHEET
SC-6-2

COMPETENCY: Route Daily Service Calls

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To prepare a daily routing schedule for service calls.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain a sample list of work orders filled in with names and address of simulated customers.	. IL-6-2 . IL-6-7
2. Obtain a map of local area.	. IL-6-10
3. Check location of simulated service calls.	
4. Locate service calls on local map.	
5. Estimate distance of service call.	
6. Route calls in order, starting with service call that is greatest distance.	
7. Designate a particular call where technician will call shop to check on re-routing.	
8. Turn completed routing sheet to instructor.	

METHOD OF EVALUATION:

1. Sequence of routing.
2. Technician shop call correct

OPERATION SHEET
SC-6-3

COMPETENCY: File Completed Repair Orders

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To review forms for completeness and to file forms in correct location.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain sample completed work order forms.	. IL-6-3
2. Check all forms for accuracy--totals of billing, customer signature, and work performed.	. IL-6-10
3. Put forms in alphabetical order.	
4. File forms in proper file under proper headings.	
5. Turn file over to instructor.	

METHOD OF EVALUATION:

1. Data correct and complete on forms
2. Forms filed correctly

OPERATION SHEET
SC-6-4

COMPETENCY: Complete a Tube Inventory

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To perform a complete tube inventory.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Secure standard tube inventory sheet.	. IL-6-4
2. Group and record all tubes according to type, numbers.	
3. Count the number of each tube type and record on inventory sheet.	
4. Use a calculator and current price list to compute the cost price of tubes.	
5. Use the calculator and current price list to compute the selling price of tubes.	

METHOD OF EVALUATION:

1. Inventory complete and accurate
2. Pricing correct

OPERATION SHEET
SC-6-5

COMPETENCY: Complete Parts Inventory

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To perform a complete parts inventory.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Secure inventory sheets and mount on a clipboard. 2. Record the following data for each part: a. part number or description b. total count c. location 3. As inventory count is taken, make an orderly arrangement of parts. 4. A portable tape recorder (cassette type) may be employed and then all data can be transcribed onto inventory sheets at a later time.	. IL-6-4

METHOD OF EVALUATION:

Inventory complete and accurate

OPERATION SHEET
SC-6-6

COMPETENCY: Buy in Discount Quantities

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To determine best source for purchase of parts.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain two parts catalogues.	. IL-6-4
2. Obtain list of parts to be identified in catalogue.	. IL-6-5
3. Look up all parts listed in two catalogues. Note any difference in price.	
4. Obtain list price for parts.	
5. Compare list price against wholesale price.	
6. Check location and research reliability of different companies.	
7. Select a company for simulated business, and give reason for selection.	

METHOD OF EVALUATION:

Compare sources,availability and quality of parts.

OPERATION SHEET
SC-6-7

COMPETENCY: Answer Telephone

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To develop desirable telephone courtesy for improved customer relations.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. When answering phone keep the following in mind: Say: "Good morning" or "Good afternoon" followed by company name--then, "May I help you?" Example: "Good morning, Triangle TV Service, May I help you?" 2. Speak clearly--do not slur words. 3. Be courteous--yes, sir--yes ma'am, etc. 4. Get caller's name, address, phone number, nature of complaint, type of receiver, color or black and white, or stereo. Determine if receiver is still under warranty, whether this is a new customer, how the new customer was referred. 5. Record all above information on a service call order form. 6. Mark CGB--call before going. SAP--soon as possible or the promised call date. 7. Do <u>not</u> antagonize complaining customers.	. IL-6-6 . IL-6-7 . IL-6-1

METHOD OF EVALUATION:

1. Observe answering techniques.
2. Required information correct and complete
3. Customer satisfaction

OPERATION SHEET
SC-6-8

COMPETENCY: Schedule Service Calls

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To prepare a schedule for service calls.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain sample list of service calls.	. IL-6-7
2. Obtain map of local area.	. IL-6-8
3. Check calls for importance, location, and any customer preference for time.	. IL-6-2
4. Arrange calls in proper order for completion.	
5. Call customer to verify time and date.	
6. Assign calls to proper technician.	

METHOD OF EVALUATION:

1. Schedule sequence
2. Customers called
3. Technicians assigned correctly

COMPETENCY: Handle Customer Complaints

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To apply courteous action to solve customer complaints.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain sample customer complaint.	. IL-6-1
2. Ask fellow student to act as customer.	. IL-6-6
3. Inquire of customer about their complaint.	. IL-6-8
4. List complaint on memo.	
5. Inform customer of intended action to rectify complaint.	
6. If customer disagrees, attempt to provide a satisfactory solution to the problem.	
7. Reschedule service and give customer assurance of satisfaction.	

METHOD OF EVALUATION:

1. Observe and critique student performance.
2. Determine if intended action is correct.
3. Determine customer satisfaction.

OPERATION SHEET
SC-6-10

COMPETENCY: Start a Business Ledger

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To establish basic business records.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain and study ledger sheets.	. IL-6-9
2. Obtain a list of completed work orders.	. IL-6-10
3. Label columns for parts, labor, taxes, expenses.	
4. Transfer work order data to appropriate columns.	
5. Double check for accuracy of information recorded.	
6. Total columns.	

METHOD OF EVALUATION:

1. Data recorded in correct columns
2. Data complete and accurate
3. Data reconciled to factual situation

OPERATION SHEET
SC-6-11

COMPETENCY: Record Debits, Credits

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To establish basic accounting practices.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain ledger sheets.	. IL-6-9
2. Obtain list of credits--incoming monies.	. IL-6-10
3. Obtain list of debits--expenses to be paid out.	
4. List all credits on credit ledger sheets in proper columns. Total columns.	
5. List all debits in proper columns on debit sheet. Total columns.	
6. Date ledger sheets.	
7. Compare or balance credits against debits.	

METHOD OF EVALUATION:

1. Data recorded in correct columns
2. Data complete and accurate
3. Data reconciled to factual situation

OPERATION SHEET
SC-6-12

COMPETENCY: Determine Proper Dress for Service Calls

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To determine appropriate dress for service technicians.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Wear clean, serviceable clothing.	. IL-6-8
2. Wear overshoes on inclement days--to be removed before going into home.	
3. Remove hat when entering home.	
4. Present a well-groomed and neat appearance.	
5. DO NOT smoke in customer's home.	
6. Do not accept alcoholic beverages during working hours.	

METHOD OF EVALUATION:

Observe daily appearance.

OPERATION SHEET
SC-6-13

COMPETENCY: Practice Employer Loyalty

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To develop a degree of loyalty that will improve working relations.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Attempt to counter criticism of employer.	. IL-6-11
2. Protect employer materials to prevent pilferage.	
3. Prepare expense vouchers accurately; i.e., don't cheat.	
4. Do not "moonlight," unless sanctioned by employer.	
5. Give employer a fair day's work for the wages he pays you.	
6. Attempt to promote employer's image at every opportunity.	
7. Do not pirate customers away from employer.	

METHOD OF EVALUATION:

Oral quiz of student regarding these points

OPERATION SHEET
SC-6-14

COMPETENCY: Determine Fair Wage for Good Workmanship

COURSE: Radio and Television Repair UNIT VI: Customer Relations and Business Management

OBJECTIVE: To develop a system for wages and pricing.

COMPETENCE - PROCEDURES/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Determine and record the amount of money you need for weekly wages. 2. List your qualifications on resume sheet. 3. Research trade magazines for national average salaries. 4. Interview local businessmen on their views on wages. 5. Compare your research with wage you desire. 6. Write a short statement on your view of wages in your area. Also state whether you would be satisfied with prevailing wage. 7. Price goods and services to accomplish goals.	. IL-6-11

METHOD OF EVALUATION:

Read statement and quiz student on viewpoint.

TITLE: Functions of Vertical Sweep Circuits

COURSE: Radio and Television Repair

1. The primary function of the vertical sweep circuit is to provide vertical deflection of the electron beam on the face of the CRT.

2. The vertical circuit generates a 60 cycle sawtooth wave which is used to deflect the electron beam.

3. The circuit consists of a sync integrator network, an oscillator, a sawtooth capacitor, a power amplifier and vertical deflection coils.

4. The sync integrator forms the six serrated vertical sync pulses in the T.V. signal into one pulse which is used to "trigger" the vertical oscillator.

5. The vertical oscillator is usually a blocking oscillator or multivibrator with a free running frequency slightly lower than the vertical sync frequency. The integrated vertical sync pulse then "triggers" this slow running oscillator on each cycle.

6. The sawtooth capacitor charges through a resistor from B on each cycle until a pulse couples from the oscillator discharges it. This creates a sawtooth wave form at the vertical sync frequency.

7. The power amplifier amplifies the linear sawtooth waveform and generates a sawtooth current waveform in the output transformer.

8. The vertical deflection coils are couples to the output transformer and when the linear sawtooth current flows through the coils a resulting magnetic field deflects the electron beam in the CRT.

9. Damping resistors are used across the vertical deflection coils to reduce "ringing".

10. A retrace pulse is coupled from the vertical sweep circuit to the CRT to blank out the electron beam during vertical retrace time.

11. The vertical circuit of a color receiver also supplied waveforms used in the dynamic convergence coils of the CRT.

COURSE: Radio and Television Repair ASSIGNMENT SHEET NO.: AS-4-8

TITLE: Vertical Blanking Interval

TEXT/REFERENCE: Basic Television, Third Edition by Grob
McGraw-Hill Book Company, pp. 52 thru 59.

ASSIGNMENT: Study carefully the reference assigned and answer the following questions.

1. What is meant by "vertical blanking?"

2. What is the length of time of vertical blanking?

3. At what frequency does it occur?

4. List the three types of sync pulses which occur during vertical blanking and give the function of each.

5. Describe the position of the electron beam on the face of the picture tube during vertical blanking.

6. On the back of this paper, draw a vertical blanking interval showing all the pulses. Indicate the number, frequency, and width of each type of pulse.